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THE EDUCATION OF A COMMERCIAL ENGINEER.

IN a previous leading article we drew attention to the ever-increasing importance of the commercial side of engineering, and it will, therefore, not be out of place to briefly analyse the training demanded by this side of the business. The moment is, perhaps, particularly opportune, seeing that Mr. J. Swinburne, in an address delivered to the students of the Institution of Electrical Engineers on the 16th inst., on "Some Difficulties of Getting On," emphasised the fact that it was the business side of engineering which commanded the highest pay, and advised his hearers not to scorn it.

There are to be found, in every calling in life, individuals who succeed in achieving success *in spite* of their training, with the result—perhaps natural—that these isolated cases are often cited as *examples* instead of *exceptions*, of the best way to set about attaining similar results. The exceptions can, however, can take care of themselves, and it is with the majority that we are here more closely concerned.

In America and Germany greater attention has been paid to the commercial side of engineering than has been the case with us, with the result that many useful lessons are to be learned from these countries, more especially as their organisations have, in many cases, left much to be desired from the point of view of the manufacturer of machinery.

There can be no gainsaying the fact that these two countries owe much of the successful expansion of their industries to the very active policy which they have adopted in extending their commercial organisations into all parts of the world, but as this expansion has been forced into a period of but a few years, comparatively speaking, it is not surprising that in many respects their commercial systems have failed—in material rather than in principle.

In this connection it is well to bear in mind that most of the productions of our engineering shops cannot be *merchanted* in the same way that staple productions are merchanted, and although many of the qualities of merchanting—an intimate knowledge of the markets, for instance—are essential, a good deal more is required in the direction of an intimate knowledge of the performances of the machinery in question—a knowledge which can only be imparted to others by those equipped with an engineering training.

The American ideal of engineering, cherished by all from the youngest upwards, is rather too much inclined to be commercial first and engineering afterwards, and although this ideal has its merits—it necessarily implies thought and an appreciation of the end in view—the necessary engineering training should not be curtailed in consequence thereof. In other words, it is dangerous to attempt to specialise on the commercial side of engineering at too early a stage, for the absence of a practical training will be severely felt in after life, even in the career of the most successful commercial engineer, and it is in most cases difficult to obtain this

training, though not so difficult to extend it, after commercial work is once entered upon.

In America and Germany the engineer who takes up commercial work is too often drawn from a class of individuals who have passed through a technical college and who may have had a year or two's practical experience on outside contract work, the few years' practical workshop training—to which so much attention is rightly paid in this country—being often omitted.

We are strongly of opinion that commercial engineers should have had practical experience in the shops, aided by study at a Technical College, and that their taste and ability for dealing with commercial matters should have been put to a natural preliminary trial when engaged on outside contract or similar work—at all events, work where their abilities for dealing with commercial matters will have had an opportunity of coming to light—before they are called upon to attend to commercial matters, and to turn their backs on technical matters pure and simple.

Subject to a fuller appreciation of the value of commercial engineers by manufacturers—an appreciation which is likely to be more fully realised as time goes on—there can be no question that from the point of view of remuneration an educated engineer can command a better stipend on the commercial side of engineering than he can in other departments.

It is therefore to be regretted that hitherto a tendency has existed among the better educated—especially those who have spent both time and money in qualifying for engineering—to look down upon commercial matters, on the ground that an expensive engineering training is thrown away on a class of work which is not strictly engineering, and which it is often wrongly supposed can be undertaken equally well by a commercial man without an engineering training.

We say it is to be regretted, because this class of individual is perhaps better fitted to maintain the traditions and commercial morality with which this country is associated, and to know where to draw the line between shrewdness—without which he can hope to achieve but little success in commercial matters—and commercial immorality, a distinction which the man of culture is usually better capable of appreciating.

There can be no doubt that American manufacturers have a great advantage over us in so far that the young American takes more seriously and kindly to commercial matters and to hard work generally than does the young Englishman of the same age, and this applies more strongly to the educated class, the source from which our business men are preferably drawn.

So far as the demand for engineers with business capacity is concerned, there is no doubt that the demand for the right men is greater than the supply, and our manufacturers are frequently handicapped in this direction.

As an instance, we might point to our foreign and Colonial trade. The American or German manufacturer opens up an agency in every foreign country where business is to be done, and either works these agencies with men drawn from his own staff, or, at all events, strengthens the staff of his agents by men conversant with the manufactures in question. The British manufacturer is more than often satisfied with the representation of agents who rely for information upon printed matter supplied from the manufacturers, and who, necessarily, cannot give the same weight to the business, and make the most of their principals' wares, as a man fully conversant with details.

In this respect it is undoubtedly the manufacturers who must take the initiative, but often this step is delayed on account of difficulty in finding suitable men for meeting the all-round requirements for which a post of this description calls.

Some Difficulties in Getting Rich.

Mr. Swinburne's speeches are invariably well worth hearing, not only for the cynical humour with which they abound, but also for the shrewd, practical views which they unfold. It does not follow, however, that we all agree with those views always, and although we are in sympathy with Mr. Swinburne as to the importance of a business training to an engineer—a matter upon which we have already expressed strong views—we regret to see that he regards "getting on," the ambition of every budding engineer, as being identical with "getting rich." The address is distinguished by two leading lines of thought—one, that the "raw scientist" is useless, because he cannot make money; the other, that the hunt for the Almighty Dollar is the end and aim of man's existence.

Referring to the first of these statements, we would have it clearly understood that the "raw scientists" of Mr. Swinburne's imagining are men who teach that to apply science to practical purposes is degrading, and that unapplied science is of a "noble and superior" quality, while business ability is contemptible. But who and where are these singular creatures? And if they really exist, what in the world have they to do with the difficulties of a student of engineering?

As for the second statement, we are happy to associate ourselves with the hypothetical students who say, in Mr. Swinburne's words, "We take higher views of life than that; there is something better for us in our careers than money-grubbing." Moreover, we are perfectly certain that Mr. Swinburne himself does not really entertain the sordid views of life which he puts forward. Why does he voice them with so much seeming sincerity?

What could be more misleading than to suggest that a man's earnings are a rough test of his *value* to the world? What are we to understand by the word *value?* Enormous incomes have been received by men whose value to the world has been absolutely negative—whose presence on its surface has been a curse—while, as Mr. Swinburne himself shows, such men as Newton and Faraday never had any but small incomes. The "rule" is specially relaxed for young men and geniuses; we note that the "youth" of a man is extended by Mr. Swinburne to 40 years, and we might add that the "rule" is so singularly distinguished by exceptions that its converse would fit the conditions better.

The fact is that Mr. Swinburne is too fond of a paradox, and paradoxes are apt to degenerate into mere self-contradictions. There is much food for thought in the address, and we trust that the right conclusions will be reached by those who read it.

Our Portrait Pages.

Our readers will observe that we have this week made somewhat of a departure from the class of matter which ordinarily occupies the special art-paper section of the Electrical Review. We venture to believe that the variation will not be unacceptable, as we have selected, as the subjects of four brief biographical notices, four of the men who are very prominent figures just now in the electrical manufacturing world. Sir Joseph Swan, though a celebrated inventor, is a representative of one of the oldest established electrical manufactories in the United Kingdom. The Hon. C. A. Parsons, first eminent as an electrical manufacturer at Newcastle-upon-Tyne, has added to that his world wide fame due to the invention and working out of the steam turbine, which has become the favourite prime-mover for the large electric power stations of to-day—though the process of time may bring something else along to supersede it. Mr. Robert Kaye Gray, the past-president of the Institution of Electrical Engineers, is a greatly esteemed scion of a manufacturing family; and Mr. Alexander

Siemens, the new president, who now holds the reins at the London meetings, and exercises a general presidential supervision over the doings of the numerous local sections, has been connected with our electrical manufacturing interests from his youth up. These four gentlemen are thus all direct and leading representatives of the electrical industry of this country. Two have been specially honoured by His Majesty in the Birthday Honours List; and two have recently honoured, and been honoured by, the great organisation which represents all sections of the British electrical profession and manufacturing industries—the Institution of Electrical Engineers.

Electricity Supply in the London Area.

The coming session of Parliament promises to be pregnant with Committee-room proceedings of great importance to those interested in electric supply work. More especially does this apply to the London area, as to which, if our American friends are to be believed, we are to-day in the anomalous position of being the greatest capital in Europe, but the worst off in the matter of electricity supply.

In the London area, among existing companies, we have the Metropolitan, Charing Cross, and County of London undertakings seeking powers to supply energy in bulk and for power purposes, to authorised suppliers within many of the hitherto exclusively municipal areas. Briefly, the Metropolitan Co. schedules in the County of London, the metropolitan boroughs of Westminster, Marylebone, St. Pancras, Holborn, Hampstead, Paddington, Kensington, Hammersmith, Chelsea and Fulham; in the County of Middlesex, the following areas:—Ealing, Acton, Hanwell, Southall, Greenford, Uxbridge, Hayes, Chiswick, Brentford, Heston and Isleworth, Twickenham, Teddington, Hampton, Hampton Wick, Sunbury-on-Thames, Feltham, Staines (Urban and Rural Districts), and Uxbridge (Rural District).

The Charing Cross Co. schedules portions of Westminster, the Strand, Holborn, and St. Giles, the City of London, the metropolitan boroughs of Islington, Stoke Newington, Hackney, Finsbury, Shoreditch, Bethnal Green, Stepney and Poplar, the County Borough of West Ham; the following areas in Essex:—East Ham, Barking, Ilford, Romford, Wanstead, Leyton, Walthamstow, Woodford, Buckhurst Hill, Chingford, Dagenham, Romford Rural District; and the areas of Edmonton, Tottenham, Hornsey, Wood Green and Southgate, in Middlesex.

The County of London Co. schedules the following:—Tottenham U.D.C., the City of London, the metropolitan boroughs of Hackney, Shoreditch, Southwark, Lambeth and Battersea, and it seeks powers to supply in any area adjoining any of the present areas of supply of the company. It will be seen that the powers sought cover the greater portion of the metropolitan and adjoining areas, and they include powers to lay mains and carry out any works required; modifications are proposed where necessary in the Electric Lighting Acts of 1882 and 1888, and in the Electric Lighting Clauses Act, 1899.

The energetic action of the companies mentioned is apparently well timed, as a new and ambitious rival appears under the style of the Administrative County of London and District Electric Power Co. The latter proposes to take powers to supply energy within the whole of the administrative County of London; the Borough of Ealing, the Urban Districts of Acton, Brentford, and several others in Middlesex; the Boroughs of Croydon, Richmond, Kingston-on-Thames, the Urban Districts of Wimbledon, Barnes, and many others in Surrey; in the County of Essex, East and West Ham, Ilford, Barking, Romford, &c., are scheduled; and in Kent, Bromley, Gravesend, Bexley and several others appear.

It may also be noted that the Ealing Corporation is applying for powers, among other things to supply electrical energy to any local authority, authorised to supply electricity, in any adjacent or neighbouring district, Croydon seeks similar powers, and the Metropolitan Electric Supply Co. applies for provisional orders for the U.D.'s of Southall-Norwood, Brentford, and for power to enter into an agreement with the Acton U.D.C., relative to the supply of energy.

RAIL JOINTS.

Some time must be allowed to pass before really definite results, suitable for comparison with others, can be expected from the extensive trials of three kinds of welded joints which are proceeding in various English towns.

The fact that the life of rails is the life of the joints, and that the life of joints is only a fraction of the possible useful existence of the body of the rail, has been common knowledge ever since the first pair of rails wore out in this extravagant manner; but it is open to serious question whether adequate advantage has been taken of the many devices which have been put forward by sanguine inventors as palliatives or actual remedies for such a profit canker. Probably, the failure of many of these devices when put to expensive practical test, has induced a "once bitten" feeling among managers. Certainly, a tradition has arisen, on the one hand, that elaborately supported joints do not realise their pretensions, and, on the other, that they represent an addition to capital expenditure which cannot be faced if the resulting economy is at all uncertain.

Again, it is more than a supposition that our backwardness in finding a solution to this terrible joint problem is due in astonishing measure to pure ignorance, for a large number of our tramways are governed entirely by the old-time manager, whose engineering knowledge is neither exact nor extensive. These men have been either responsible for the defective design of special joints, or have failed from a lack of engineering instinct to discover the flaws in other people's designs, which they have accepted. We suffer now for the optimism of untrained intellect.

A combination of ignorance and false economy, for instance, accounts for the following sketches which were obtained from the ends of rails removed from active service some two years ago. Imagine the pleasant riding over such joints! Imagine, too, the condition of the rolling stock after a few years of such riding!

Sections of Old Rails.

Chiefly to meet the depreciation of rail joints and the consequent renewal of rails, accompanied by the relaying of the paving, Glasgow puts aside £450 per single track mile annually, and wise men applaud her wisdom, thinking the sum not too much. Can such expenditure be an eternal revenue charge? Surely not, when an easement depends solely on the discovery of a junction between rail ends which shall make the life of the whole rail the same.

We have given some prominence to the systems of so-called welded joints which have been developed within the last few years, and so far as we have shown a bias towards any one of them it has been in the direction of the latest, the simplest and the cheapest. While the two older systems cart their paraphernalia about in special trains, the Goldschmidt process requires apparatus which may be compressed into a cab, operators and all.

Our readers will be familiar with the details of this process, and we do not intend to describe it here, but we desire to draw attention to a most important article by William H. Cole in *Street Railway Journal* for September. Desiring to obtain some definite results as to the effect of hardness in rails, and on the merits of various kinds of bonds and joints, the author carried out tests on rails laid in a line subjected to heavy traffic. The observations extended over 12 months, and the results tend to confirm our opinion about the thermit joint. With the joints made by this process, "there seemed to be no more wear at the joints than at any

other part of the rail, and at the end the relative conductivity seemed to be the same as at the beginning." The electrically-welded joint was not tried, but the cast-weld had to take second place to the thermit weld, while "all the fished rails showed appreciable wear at the joints, with considerable pounding as the wheels rolled over them." Fished joints involve bonds, and the article exposes a most remarkable decrease in relative conductivity, at the end of one year, across all the bonded joints under test, while even the cast-welded joints dropped 11 per cent. The Goldschmidt welds, on the other hand, began 1 per cent. above the resistance of an equal length of solid rail, and still were ·4 per cent. above at the end of the test.

The author strikes home very hard when he writes:—"Unless a perfect joint is obtained, no one need worry about the quality of the steel in a rail, for the very cheapest that one can buy will last longer than any of the joints, unless it is welded properly, and made into a continuous rail."

Is it not quite true that elaborate specifications controlling by minutest quantities the carbon and other ingredients of steel rails, might just as well never have been drawn up? A rail as cheap as could be dumped, would be mourned less at the scrapping, when sorrowing engineers curse the joint that killed it.

That there is much virtue in a careful specification when joints have not to be considered, is demonstrated with effect by Mr. Cole, and this is the mixture he considers best for tramway work: Carbon, ·55 to ·58; Silicon, ·10 or under; P, ·08 or under; S, ·06 or under; Mn, ·83 or under. Three grades of rail were tried, and the estimated life of each for ·2-in. wear (this being assumed as the extreme limit under the best condition) was as follows, when the Goldschmidt weld was used:—Soft (C = ·284 per cent.) 11·9 years; medium (C = ·572 per cent.) 18·8 years; and hard (C = ·591 per cent.) 6·9 years. Those are the lives for the particular services run over the line where the rails were laid, and it may be gathered from the figures that the tests were made under very severe traffic conditions.

The bogie, haunting continuous rails in the minds of many a tramway manager, is the old, old, contraction and expansion sprite, and nothing but personal experience will suffice to lay it for ever for these men.

They point to the open joints on railway rails, and ask why butt joints should succeed on tramways when they have proved unsuitable on railways, forgetting that welded joints are made at high temperatures, that the variation of air temperature from the mean is small in England, and that the rails are buried except for the tread, and, to a great extent, held rigidly between masses of paving stones.

If the continuous rail does not come into fashion quickly, there will be sore hearts in many a council chamber and board room, and the day of the railless motor-car will be nearer at hand.

THE PATENTS ACT, 1902.

We have frequently had occasion to refer to the provisions of this Act, which is destined to revolutionise the law of letters patent in Great Britain and Ireland. The most important sections of the Act, *e.g.*, Sub-secs. 1 and 2, which relate to the examination of previous specifications in the United Kingdom, and to the limit as to anticipation, are not yet in force; but they are to come into force on and after December 31st, 1904, in accordance with certain rules which were issued on November 9th by the Board of Trade. In view of the importance of the new changes in procedure to every inventor and patentee of electrical apparatus, we propose to explain the nature of the new rules; and in order to secure their proper appreciation, it will be necessary to explain the changes in the law which are made by the Act of 1902.

The new rules made in accordance with Sec. 1, Sub-sec. (3) of the Act of 1902 appear to be drafted with a view to making the investigation at the Patent Office as simple as possible. Thus by R. 4 it is provided that the statement of the invention claimed, with which a complete specification must end, shall be clear and succinct as well as separate and distinct. Again, when a specification comprises several distinct matters, they shall not be deemed to constitute one invention by reason only that they are all applicable to or may form part of an existing machine, apparatus or process (R. 5). But the rule goes even further than this, as it provides that where an applicant has included more than one invention, the Comptroller *may require* or allow him to amend his application, specification and drawings, or any of them, so as to apply to one invention only, and the applicant may make such application for a separate patent for any invention excluded by such amendment. If the Comptroller requires or allows any application, specification, or drawing to be amended as aforesaid, such application shall, if the Comptroller so direct, bear such date, subsequent to the original date of the application, and not later than the date when the amendment was made, as the Comptroller shall consider reasonably necessary to give sufficient time for the subsequent procedure relating to such application.

The effect of this rule is that, if a patentee chooses to muddle up one invention with another, he may run the risk of having his application post-dated—a matter of considerable moment, when it is remembered that the date of application is the all-important date.

The procedure under the section above set out is prescribed in Rules 6 to 10, which may be thus epitomised:—

If the Examiner reports that the nature of the invention is not sufficiently disclosed to enable him to make the investigation, and the Comptroller has required an amendment, or the application shall, if the Comptroller at any time so direct, bear such date, subsequent to its original date, and not later than the date when the requirement is complied with, as the Comptroller may consider necessary to give sufficient time for the subsequent procedure relating to the application.—R. 6.

When the Examiner finds that the invention claimed in the specification under examination has been wholly claimed or described in one or more prior specifications, he shall at once make a provisional report to that effect to the Comptroller. If the provisional report of the Examiner be not reversed or altered, it shall be deemed a final report, and the application shall be dealt with as provided by Sub-sec. 6. If, however, such provisional report be reversed or altered, the investigation shall be continued, and a further report shall be made to the Comptroller, and the specification shall be dealt with as provided in Sub-sec. 5 or Sub.-sec. 6 of the Act of 1902.—R. 7.

The time within which an applicant may amend his specification is two months from the date of the letter informing him that the invention claimed has been wholly or in part claimed or described in any prior specification or specifications.

In any special case the Comptroller may, if he think fit, enlarge the time prescribed by this Rule.—R. 8.

When the applicant has been informed of the result of the investigation of the Examiner, and the time allowed for amendment has expired, the Comptroller, if he is not satisfied that no objection exists to the specification on the ground that the invention claimed therein has been wholly or in part claimed or described in a previous specification within the meaning of that sub-section, shall inform the applicant, and appoint a time for hearing him, and give him 10 days' notice at the least of such appointment. The applicant must then notify the Comptroller whether or not he desires to be heard. The Comptroller shall, after hearing the applicant, or without a hearing, if the applicant has not attended a hearing appointed, or has notified that he does not desire to be heard, determine whether reference ought to be made in the applicant's specification to any, and, if so, what, prior specification or specifications by way of notice to the public.—R. 9.

When the Comptroller determines that a reference to a prior specfication ought to be made by way of notice to the public, the form of reference shall be as follows, and shall be inserted after the claims:—

> Reference has been directed, in pursuance of Section 1, Sub-section 6, of the Patents Act, 1902, to the following specification of Letters Patent No. , granted to .

Where the reference is inserted as the result of a provisional report under Rule 7, a statement to that effect shall be added to the reference.—R. 9.

Every decision of the Comptroller under the foregoing rules shall be subject to an appeal to the Law Officer.—R. 11.

Nearly all the remaining rules relate to the size, &c., of the drawings which are to be deposited, and need not be further noticed here.

Colliery Installation.—Messrs. A. Hirst & Son, Ltd., of Crescent Works, Dewsbury, have secured an order for an electric generating and haulage plant, to be installed at the Wheldale Colliery, Castleford. The plant comprises a 150-kw. dynamo direct-coupled to a high-speed vertical engine, two 60-h.p. motors, and one of 24-h.p., two hauling gears, and over three miles of heavy cables.

THE COMING OF THE GAS TURBINE.

By E. KILBURN SCOTT, A.M.I.C.E., M.I.E.E.

It is not generally known that, some five or six years ago, experiments were being made in Leeds with a gas turbine. The machine was modified from a De Laval, and was actually made to run. Certainly, it did not run very long, and nothing much has been heard of it, but this is partly attributable to the limited resources of those engaged in the work.

Since then, the rapid development of steam turbines and large gas engines has shown that the days of the reciprocating steam engine are numbered, and this is, naturally, having the effect of causing steam engineers to look around for a new prime mover, and some in this country are already at work on the gas turbine.

One of the more significant facts which came to the writer's knowledge during a recent visit to the States, was that both the large electrical concerns (at Schenectady and Pittsburg) were experimenting with gas turbines. It is only within recent years that either of these firms, or, indeed, anyone in America, has seriously considered turbines, but when they did take hold of the steam machine, they lost no time in developing it, with the result that one has now to go there to see the latest and largest practice. It is all the more interesting, therefore, to find them at work on the gas turbine problem.

The paper read recently before the Institution of Mechanical Engineers by Mr. R. M. Neilson, on the possibilities of gas turbines, comes at a very opportune time, and it is an especially valuable contribution, because the author carefully points out the theoretical principles which investigators must bear in mind. He shows that when working on Carnot's cycle, between 1,600° and 17° C., the greatest possible efficiency is—

$$\frac{T_1 - T_2}{T_1} = \frac{(1,600 + 273) - (17 + 273)}{1,600 + 273} = 85 \text{ per cent.}$$

Whilst a reciprocating gas engine working on the Otto cycle with compression to 60 lbs. per sq. in., combustion at constant volume, and expansion to atmospheric pressure, gives at most only 37 per cent. An important point to note is that it is relatively more important to have the lower temperature *low* than to have the higher temperature *high*. Thus an ideal gas engine working on Carnot's cycle between the limits of temperature 2,000° C. and 300° C. absolute, will lose as much by an increase of 100° C. on the lower temperature as it will by a decrease of 500° C. from the higher temperature. This is good, because it is clearly much easier to build a turbine for a low temperature than for a high one, indeed, it is doubtful whether turbines can be water-jacketed effectively to withstand an initial temperature of 2,000° C.

Of course, in any form of motor using gas, a large amount of heat must necessarily be lost in the water, and the higher the initial temperature the greater will this amount be. It has been suggested to utilise this heat by raising the water to boiling point and then passing the steam along with the gas through the turbine, but clearly a better way would be to utilise the steam in the gas producer, and thus dispense with separate boilers.

One of the principal difficulties which has to be met in turbine design is to fully utilise the full velocity of the steam or gas. Thus saturated steam at 300 lbs. absolute, expanded adiabatically from a De Laval nozzle, has a velocity of over 4,000 ft. per second, and with gas the velocities which will have to be dealt with, are likely to be still higher. Now, such velocities as these are far greater than the peripheral speed at which metallic bodies can be run.

The difficulty has been very fairly met in the Curtis, and to some extent in the Westinghouse steam turbines for Chelsea, by arranging the expansion in stages and combining the De Laval nozzles with Parsons' vanes. It is probable a construction such as this, will meet the conditions of the gas turbine.

One advantage which gas has over steam in a turbine, is that there cannot be any water present with the former, and therefore liability to cut the blades as well as friction in the nozzles, &c., is reduced.

It is, however, not so much the steam turbine as the gas engine, that the gas turbine will eventually have to reckon with. The usefulness of steam machinery is limited by the wasteful method of burning coal on a fire grate, and also because steam boiler units cannot be built much larger than 1,000 H.P. Therefore, however much the steam turbine itself may be perfected, it will always be handicapped by the boiler side of the proposition.

In order to more fully understand the chances of the gas turbine as the coming prime mover, it may be interesting for a moment to draw some comparisons between the gas engine and the gas turbine :—

(*a*) It is clear that one great advantage of working with gas, is that in a turbine it can have practically a continuous flow, whereas in the engine it must be cut off at every working stroke—usually one in four—with a liability to back firing which is absent in the turbine.

(*b*) The turbine is able to do its own scavenging automatically, by the mere fact of the gas entering at one end, and the products of combustion leaving at the other. With an engine the charge may be, and generally is, compressed in the cylinder, but in a turbine it must be compressed separately. This can be effected in a remarkably simple manner by the turbine rotary pump, which has been developed with such success in connection with colliery ventilation, &c.

(*c*) Perhaps the greatest difference between the gas engine and turbine, is that in the engine the metal surface with which the gas comes into contact, is small compared with a gas turbine, especially if multiple expansion is attempted, because almost every particle of gas must necessarily slide along a metal surface as it passes through the vanes. Fortunately, however, the rotating and fixed portions do not come into intimate contact as is the case with the piston and cylinder of an engine, and, therefore, the metal surfaces may be worked at much higher temperatures.

(*d*) As with engines, so gas turbines will require to be water jacketed, the extent of such jacketing depending on the method of working. For example, if the temperature is below 1,000° C., it is probable that jacketing the outer casing, may meet the requirements. For 2,000° C., however, it will be necessary to have water circulating through the spindle, and the rotating rings and blades. At first sight this may be thought somewhat difficult, but after all it is much less of a mechanical problem than providing a water supply in the piston of a large gas engine, which latter is necessary to prevent back-firing.

(*e*) Regarding the governing, there is on the face of it a distinct advantage in favour of the turbine, because of its not having any dead centre, and the regulation can be so simply effected by shutting off more or less nozzles as in the Curtis steam turbines. The gas engine, on the other hand, requires a heavy fly-wheel, and if economy of gas is aimed at by using the hit-and-miss form of governor, then the fly-wheel becomes exceedingly heavy.

So far as actual construction is concerned, the principal difficulties experienced up to now, have been the sooting up of the nozzles and other working parts, and the shrieking noise, this latter being perhaps the more formidable of the two. The Hon. C. A. Parsons, C.B., had a much tougher job before him when he developed the original steam turbine, for the modern investigator has a mass of facts to work from, and he is also at an advantage in having better and stronger materials, and much more accurate machine tools at hand. A large number of the details must be the same as for a steam turbine, and the elaborate gas engine trials of recent years are available for the investigator.

FIBRE DUCTS FOR CABLE LAYING.

We have received from Mr. Leonard Andrews, A.M.I.C.E., M.I.E.E., of the Key Engineering Co., Ltd., Manchester, particulars of a system of cable laying which has been used in the United States for the past 10 years, but is practically unknown in this country. Mr. Andrews points out that electrical engineers hold widely different opinions on the much discussed question of laying electric-light mains. Some pin their faith to armoured cables laid directly in

the ground; others prefer plain lead-covered cables laid in troughs filled with bitumen, whilst many others will have nothing but some form of drawn-in system. Each particular system has its peculiar advantages, and it is impossible to obtain any system in which all the advantages of other systems are combined. After enumerating

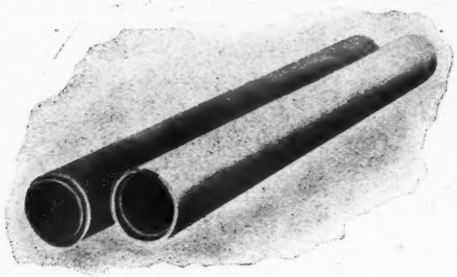


Fig. 1.

the advantages and disadvantages of some of the systems in question, Mr. Andrews refers to the system of fibre conduits laid solid in concrete, for which the following advantages are claimed:—

The cost of this system is considerably less than that of a high-class earthenware conduit, even when the latter is laid direct in the ground.

Excellent mechanical protection is secured, and there is no risk of injury from subsequent disturbance of the ground.

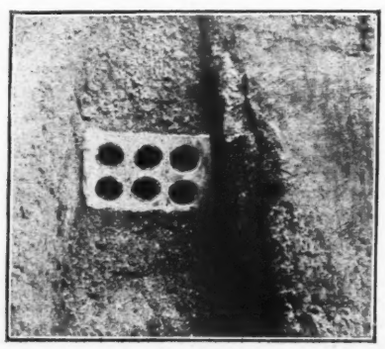


Fig. 2.

The conduit is an excellent insulator, and is absolutely water-tight. The strain between conductors and earth is, therefore, reduced to a minimum, and electrolytic troubles are entirely overcome.

It is very simple to lay—one man has laid over 6,000 ft. in 10 hours.

It is very light, and the cost of cartage and handling is consequently low.

It is entirely unaffected by salts or acids.

It is tough and mechanically strong. The percentage of breakages is in consequence very small.

It is supplied in 5-ft. lengths.

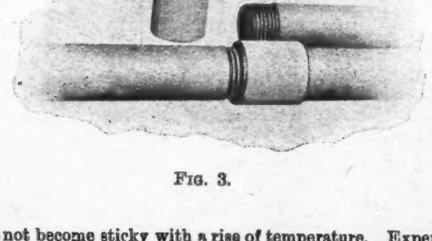


Fig. 3.

It does not become sticky with a rise of temperature. Experience has shown that cables that have been laid some years can be drawn out as easily at the end of that time as they can be drawn into a new earthenware conduit.

The system in question was first brought to his notice a few months ago, and he has since persuaded a number of engineers in this country to lay some trial lengths; they all, without exception, report favourably upon it.

The conduit is composed of a mixture of wood fibre, bitumen and paraffin wax, the method of construction being such that all ingredients are thoroughly mixed in the exact proportions which long experience has shown to best meet the conditions obtained.

Fig. 1 shows the general appearance of the conduit. It will be seen that each length has spigot and socket joints that fit perfectly into each other, making an excellent joint of the same external diameter as the rest of the pipe.

In New Jersey, U.S.A., over 260,000 ft. of this conduit were used in one installation for the construction of a 30-way nest of ducts. After the excavation was made, a bed of concrete was placed on the bottom of the trench, then a line was drawn taut on one side, next to which was laid the first line of duct. The remaining lines of duct were laid parallel to the first and separated ¾ in. from each other by means of wooden pegs. After the first layer was laid, it was covered with concrete and well grouted, sufficient concrete being used to cover the first layer to the depth of ½ in. The succeeding layers were laid in exactly the same way. The majority of the ducts were laid in five layers, of six ducts per layer. Owing to an obstruction, a portion of the system was laid in two layers, of 15 ducts per layer.

This was an exceptionally difficult installation, owing to the large quantity of water present, necessitating the frequent use of an electrically-driven hydraulic pump. But, even though the conditions were unusually severe, the contractor made a record—one man in the trench and two helpers above laying over 15,000 duct ft. (nearly three miles) a day, exclusive of concrete.

The end of a six-way socket fibre conduit laid in concrete is shown in fig. 2, while fig. 3 shows a heavier build of conduit, with screwed couplings. This conduit is largely used for laying single-way ducts directly in the ground, in positions where the cost of concrete would be prohibitive.

INSTITUTION OF ELECTRICAL ENGINEERS.

Abstract of Inaugural Address delivered to the Manchester Section on November 18th, 1904, by C. D. Taite, Chairman (Borough Electrical Engineer, Salford.)

This Section is now, and has been for some time, by far the most important branch of the parent Institution, embracing as it does over 700 members of the various grades.

A Students' Section was successfully inaugurated last Session, and this immediately led to a large increase in the number of students belonging to the Section, who start the Session with about 250 members.

The subject with which I propose to deal principally is electricity supply undertakings, and having had the privilege recently of a tour in America, I propose to discuss a few points in which American practice differs from our own.

Both in this country and in America, the electricity supply business started in a very modest way with small stations. In Britain, with the sole exceptions of London and Newcastle, competition in the supply business was prohibited, one provisional order being granted for each city, town or district. In America, on the contrary, a town of the size of Chicago or Philadelphia, would be divided up amongst quite a number of companies, each operating on a comparatively small scale. The development was more rapid over there, on account largely of the absence of vested interests, and also because the overhead system of supply enabled cables to be run more easily, and much more cheaply than in this country. Current is supplied in the States almost universally at a pressure of 110 to 120 volts direct current for lighting, and 230 volts for motors, as compared with our pressures of from 220 to 250 for lighting, and 440 to 500 for power.

When the higher pressure lamp came along, the Americans, with very few exceptions, did not make the change, and probably will never do so now. The result is that their distributing systems—so far as they are laid underground—are very much more expensive than ours, and where the supply necessitates transformation, sub-stations have to be much more frequent than over here.

At the present time, one generally finds in each city only one company operating, this company being a consolidation of the many pioneer companies. By a series of developments, therefore, America has arrived at a point which our authorities foresaw from the first, and provided for by refusing to sanction more than one provisional order for a given area.

In England we are rapidly becoming converted to the advantages of steam turbines for driving our large units, particularly for alternating current work. In America it did not appear that the turbine was making such rapid headway as in this country; one could not help being struck, for instance, by the very large number of slow speed machines in course of construction going through the shops of the General Electric Co. and the Westinghouse Co., of America. On the other hand, at Boston and Chicago, turbine stations are in course of construction. In both these stations, but more especially in the case of the Chicago station, the division of the plant into units complete in themselves has been very thoroughly developed. The arrangement, in fact, was practically the same as in the Carville power station in Newcastle, the boiler house being at right angles to the engine room.

With regard to the control of these large units, the Americans have adopted everywhere a complete system of oil-break motor-driven switches with electrical remote control; in some cases duplicate control boards have been provided, so arranged that while one remains in use the other cannot be operated. Duplicate bus-bars appear to be universal, and they are so designed so as to render it possible to sub-divide the feeders and sub-stations which they supply into distinct groups, each of which can be fed by a separate machine. The safety of the employés has been dealt with most thoroughly, and elaborate precautions have been taken to prevent breakdowns, and to minimise their effect.

Great attention is given to the personal comfort of the staff, and the opportunity is given to them to improve their technical knowledge by providing them with club-rooms, where they may meet and discuss matters of interest; these rooms are open not only to the technical and office staff, but to every man employed by the company, however humble his position. The men avail themselves largely of the facilities offered them to improve their knowledge, and this system of encouraging all grades of workmen to learn is a good one, which station engineers over here may with advantage take into consideration.

In America there appears to be a much greater desire to gain knowledge than is the case in this country. At Harvard University no less than 25 per cent. of the students earn their living while prosecuting their studies. This enthusiasm for work is encouraged by employers, who have created a big demand for college-trained men; these men are paid from the day on which they start work, and their future promotion depends on their own ability and industry.

Turning to the question of the transmission and distribution of electricity, we find in America, conditions which do not exist in this country. In many parts of the country, water-power, remote from any large centres of population, has to be transmitted to the towns, with the result that overhead systems, working at what we should consider excessively high pressures, are quite widely used. The longest transmission scheme which was visited by the I.E.E. on the occasion of the recent tour was that from Shawinigan to Montreal, a distance of about 90 miles. Power is transmitted on this system at a pressure of 50,000 volts, the current being three-phase at 30 periods, and the conductors being of aluminium.

Three-phase transmission was developed much earlier than in this country, but it is noteworthy that the distribution schemes are almost invariably on the original system of three-wire direct current at 110 to 120 volts, with a certain amount of alternating current for the scattered suburbs. The question of speed regulation of motors, has undoubtedly had a great deal to do with the general adoption of direct current, while not only did expense stand in the way of any change to a higher pressure, but the lower pressure was preferable, owing to the higher efficiency claimed for the lamps. At the present day there is little to choose in efficiency between lamps of 110 and 220 volts, and the saving in capital expenditure makes the higher pressure undoubtedly the more economical for both supplier and consumer.

The Edison companies control a large number of stations, and arrange matters so that the standard pressures in the various towns differ slightly; this is done in order to utilise to the fullest extent the lamps turned out by the lamp makers, the specification and standardisation of these lamps, for the various pressures, being very rigid.

Where overhead systems are carried to excess, particularly in Pittsburg and Montreal, the effect is most disfiguring; on the other hand, there is a good deal to be said for overhead conductors for scattered areas, whether they be suburbs of a large city or only a country district.

Electricity is in much more general use in America for all purposes than is the case in this country, in spite of the fact that in the large cities, at any rate, the price charged is considerably higher than in England; thus, in Boston, where they have a lamp connection of 500,000 16-C.P. lamps, and 24,000 H.P. in arcs and motors, the normal flat rate for lighting is 10d. per unit, subject to discounts according to current consumption; a small power consumer pays 3d. per unit, and the lowest figure quoted to any party is 1d.; on these prices we were informed that private plants are rapidly being given up.

At Chicago the price was on the maximum demand system, with Wright indicators, the tariff being for lighting 10d. for 30 hours' use per month of the maximum demand, and 5d. for all current used in excess; similarly for power the price charged was 5d. and 2½d. Similar prices were charged in most of the other large cities visited.

With regard to output, the New York Edison Co., with a population in its area of about 2,000,000, has a maximum load of 50,600 KW. for lighting and power, with an annual output of 131,000,000 KW.-hours, which is a greater output than all our London companies and municipalities combined, can muster. Montreal is an exceptional case, but it is so interesting that its position is worth recording; it has a population of 350,000, and 10,500 customers, compared with the 5,171 consumers of Manchester with a population nearly twice as large; the annual consumption which includes power for the tramway service, is no less than 85,000,000 KW.-hours, and the company which supplies the current is the fortunate possessor of a 75 per cent. load factor. Amongst the consumers at Montreal is a 3,000 H.P. cotton mill, which is driven throughout by electricity, paid for at the rate of ½d. per KW.-hour; the mill has arranged its hours of work, so that in certain winter months no current is taken between the hours of 4 and 7 p.m., hence the low rate of charge; this alteration has only necessitated a reduction of the average weekly working hours from 56 to 54; we were informed that the output from this mill had increased 40 per cent. since the conversion to electric driving, owing to the greater flexibility of the system and improved machinery, as compared with steam driving; that 40 per cent. represented greatly increased profits, the costs, exclusive of the raw material, being practically constant. Other consumers in Montreal are given the benefit of a reduced tariff in cases where they undertake not to use their supply in winter months between the hours mentioned above; this system has been adopted to some extent in this country, notably at Brighton, but it is evident that if we are to bring up our load factors to anything like the same figure as at Montreal, we must, under certain conditions, reduce our price much below anything quoted at present; there is, no doubt, but that it would pay many of our North country stations handsomely to supply current between certain hours at ½d. per unit, and it would not require much modification of mill hours to accommodate themselves to a power supply, which would only be shut off in the months of November, December, January and February, from 4 p.m. to 7 p.m. Such a striking example of what can be done in the way of obtaining a good load factor is well worth the consideration of all those who have to deal with the supply of electricity in this country, it being remembered that improvement in the load factor, even if it be obtained at a low margin of profit, must eventually be the means of a reduction in price to the general body of consumers.

Municipalities in America have not cared to take up the position of public suppliers of electricity, as has been done in the country; they have instead given franchises, usually for 50 years or thereabouts, to companies, who appear to be organising their business on a very sound basis. The companies frequently have a wiring department, and in some of the cities this department nearly monopolises the wiring business of the city.

The lamp question has been solved in America by giving the consumer free lamps. Every consumer starts his installation with lamps furnished by the supply company, nominally on loan; he may have these lamps changed as often as he thinks fit, and in the case of the theatres, where coloured lamps are frequently required, they are often changed weekly without any charge outside the cost of carriage. All lamps prior to being sent out, are tested for candle-power and consumption, the limit for a 16-C.P. lamp being in the region of 14·5 C.P., and the consumption, 3·2 watts per C.P. When lamps are brought in, should they give less than 14·5 C.P. at normal voltage, they are, if sufficiently good, put aside for colouring for shop signs and theatrical purposes; otherwise, if too much blackened, they are destroyed. The life of the lamps is only reckoned as about 500 hours; their price is 7½d. We were told that the system of giving lamps free added about ¼d. per unit to the price, but that figure seems to be rather under the mark, the total cost of the system being between ½d. and ¼d. Be that as it may, the effect of the system on the incandescent lighting is very, very marked; lamps in the shop windows always look bright, and give a good light, and blackened lamps are as rare in America as they are common in this country. It is difficult, however, for engineers in this country to recommend their directors or committees to adopt exactly the same system here; the wiring is in the hands of the contractors, who calculate to make a steady income out of the sale of the lamps, and there would naturally be a great outcry if the free-lamp system were introduced on a large scale. On the other hand, some such system seems to be the only way of ensuring that the consumers get a thoroughly satisfactory light, with a minimum expenditure of energy. The American system, however, has its drawbacks; thus the consumer, being assured of a free supply of incandescent lamps, has a very little encouragement to try any new type of lamp, such as the Nernst, and it is a fact that, in America, so small is the demand for Nernst lamps, where direct current is supplied, that a design suitable for direct current has not yet been put upon the market; this lamp is in the hands of the Westinghouse Co., and is used on alternating current circuits only.

It is a remarkable fact, and one much commented on in America, that while the American generating costs are, as a whole, no greater than similar costs in England, being, in fact, considerably lower than are obtained, generally speaking, by London stations, yet the selling price of current in America has to be considerably higher than the price in England, in order to obtain the same return on the capital invested. In America the coal bill is low, due to the use of large and economical units, but the capital expenditure per KW. installed is high, owing to the charges which have had to be made in assimilating the systems of the various companies, and in effecting the consolidation. It cannot be driven home too strongly that a heavy capital expenditure per KW. installed is bound, under ordinary conditions, to necessitate a high tariff with a correspondingly restricted business. To undertakings which intend to cultivate a power load, this is a matter of great importance, and I am of opinion, therefore, that where current has to be transmitted to scattered areas, overhead wires should be as far as possible adopted; where it is necessary, as in the case of the power companies, to convey electricity in many directions over huge areas, it would seem that overhead conductors are essential, if the companies are to attain financial success. That it is important to all of us, in whatever branch of the profession we are employed, that these power companies should be successful, is, I think, self-evident; any development in the use of power in their areas cannot but stimulate the demand for electricity throughout the country generally. Apart from the supply of power to mines and factories, they should have a large sphere of usefulness in supplying energy, not only to those towns which have not generating stations of their own, but also to those which have; in many cases I think it will be found to be to the best interests of those concerned to purchase energy from outside, in preference to carrying out expensive extensions to existing works, provided that the prices quoted are as reasonable as one has been led to suppose they will be; in any case, municipalities and others will do well before embarking on extensive schemes of expansion to inquire what the power companies are prepared to do, and to compare the terms quoted with their own costs, not forgetting the effect of the proposed capital expenditure on the selling price.

In conclusion, I am glad to have an opportunity of placing on record my great appreciation of the facilities afforded us, by the American Institute of Electrical Engineers, on the occasion of the recent tour, for fully investigating the most recent practice in the generation and distribution of electrical energy in their country.

A hearty vote of thanks was moved to Mr. Taite for his interesting address, and the meeting then took the form of a smoking concert, for the musical portion of which Mr. Giles was responsible. Mr.

Taite proposed that the best thanks of the meeting be given to Mr. Giles for providing the entertainment, and asked all present to join with him in drinking the health of Mr. Giles, and wishing him *bon voyage* on his leaving England to take up an important appointment at Capetown. Mr. Giles, in responding, thanked the chairman and members for their good wishes, and said that he felt very keenly the parting from so many of his engineering friends.

Mr. Ramage, the hon. secretary, remarked that he hoped the first meeting of future sessions would be started in a similar manner to the present one, as it was possible for the members to get into closer touch with each other at a meeting of that kind, than at the ordinary meetings.

A hearty vote of thanks to the artistes brought the proceedings to a close.

SOME DIFFICULTIES IN GETTING ON.

Abstract of an address by J. Swinburne, Past-President, to the Students of the Institution of Electrical Engineers (delivered November 16th, 1904).

The first difficulty is to know what equipment is necessary, and how to get it. At once each of us is confronted with the question, "What is going to be my work?" In engineering it is quite impossible for any one to start out with a definite career before him. A man who has made a specialty of electric waves, gets his first appointment as inspector of meters to an electric light company, and so on. Probably each man should have a general knowledge of applied physics, and chemistry and mathematics, and a special knowledge of one or two subjects. If you glance round at the work of some of our big men, you will be surprised to see how many have made their reputation by doing one small thing, but doing it well. If a man gets to the front in one narrow subject the world credits him with the knowledge of all the rest. It is, however, even easier to acquire a large general knowledge than an advanced special knowledge of one narrow subject. The specialty must not be too narrow either.

One of the great difficulties is to keep knowledge in a polished state ready for immediate use. In practice it may have to lie idle for long periods and then be wanted very much on short notice. The great thing is to master a certain number of broad fundamental principles which give a starting point for refreshing old knowledge or acquiring new. For instance, in physics, the law of conservation of energy and all that follows from it; the principles of the kinetic theory of gases; the ideas of lines or tubes of force; the principle of the interlinked circuits; the principle of the growth of entropy in all thermo-dynamic changes.

One of the greatest difficulties in getting on arises from the idea, which is carefully fostered among English science teachers, that there is something degrading in applying science, and that business ability is an inferior quality which is to be despised. All teaching is hopelessly unpractical, and the teaching of science is wholly unpractical. This is not due to a curious perversity among schoolmasters in general or science teachers in particular; it is a perfectly natural and, I believe, quite unavoidable result.

Ordinary school education is entirely and hopelessly useless. In science and technical training the same unavoidable evolution towards the unpractical is always going on. Science, for which no use has been found or which is not applied, is called "Pure Science," whereas it is really the raw material, and should be called "Raw" or "crude science." There is an assumption of superiority in the term "Pure Science," and generally the term "Science" is appropriated by workers in raw science in much the same way as the term "working man" is appropriated to the exclusion of the brain workers. There is no more baneful influence on the technical advancement of this country than the Royal Society ideal in science.

It is often said that the pursuit of knowledge has a nobility of its own. But what knowledge? No knowledge is worth obtaining for its own or any other sake, unless it is or will probably be useful to man.

I would earnestly urge any of my hearers who has the idea that there is something noble and superior about "Raw Science," or who think little of business men, to get rid of all such notions if he hopes ever to get on. If you look round the electrical industry, or round the industries generally, who are at the top? Always the business men. The men at the head of large industries generally know very little science. A man may run a large electrical industry with the most vague ideas as to the true relation of the electro-static and electro-magnetic systems of units. If he wants good technologists, he employs them. If he wants practical men who can take commercial responsibility he pays good salaries; if he wants men full of book knowledge, he pays low salaries, but he does not generally want them. The science teacher looks down with contempt on the engineer as an ignorant, rule-of-thumb inferior person, and the engineer in his turn looks down on the business man as a money-grubbing person with no brains and no lofty ideals; but this is all topsy-turvy.

A man's value to the world at large may generally be roughly estimated by the income he earns. The business man comes out far away above the engineer. He employs the engineer; the scientific man is his servant. Just as the raw scientist looks down on the engineer, and the engineer looks down on the business man, so the business man has a contempt for the engineer; and the engineer in his turn looks on the raw scientist as an unpractical crank.

I do not for a moment mean to say that text-book science is not of priceless value—of course it is—and the more scientific knowledge you or I, or, still more, the leading engineers, have, the better; but most of us suffer from too little common sense in proportion to our scientific knowledge.

There is a wide distinction between the man who can earn a few hundreds a year and the man who earns as many thousands. It is a very curious thing that there is hardly anything between. One type of man will either earn his few hundreds a year all his life, remaining permanently an assistant, or he will undertake responsible work and get into fair figures. The engineer who is worth £750 a year seems hardly to exist, except for a short time on his way from one class to another. This is what is meant by the saying that there is plenty of room at the top of the ladder.

If you come down to the raw scientist you find that the industrial world has no use for him at all, and will not pay him anything, and will not employ him. The only opening he has is in teaching; and if he is not very unpractical there are a few Government appointments for him. You will find practically all our leaders in raw science are science teachers. It may be said that this shows they are useful. It does not.

Schoolmasters naturally have the idea that what they are good at is most important, so a huge convention is set up. The value of what is called "learning," "culture," "education," or more often "knowledge," is purely a convention with no foundation in fact.

When I say that a man's earnings is a rough test of his value to the world, a great exception must be made in the case of genius. A genius does not work for a given employer; he works for the world at large; and the world at large does not pay him. It would be ludicrous nonsense to say that the value of Newton or Faraday could be reckoned in terms of their pecuniary earnings. They did grand work apparently because they were impelled to do it without any selfish motive. This is true of the great scientific men of to-day. We think now that we have no Newtons among us; the next generation will look back with envy to the present time as the day of great scientific men. The broad rule about measuring a man by his earnings breaks down, not only in the case of great geniuses, but to a proportionate extent in the case of many original workers in unapplied science. As soon as research becomes a means of advancing the individual by getting him better appointments as a teacher, or getting him kudos—taking genuine kudos as part of the earning, the rule holds good.

In the Charter of the Institution of Civil Engineers, the engineer is defined as "Directing the great sources of power in Nature for the use and convenience of man." With all respect to this august body, and their often-quoted definition, I would humbly suggest that it is bad; it is really the definition of a scientific man. It is incomplete as applied to an engineer, because it does not take into account the sordid element of price. An American definition is much better:—"An engineer is a man who can do for one dollar what any fool can do for two." This is not poetical, and is useless for oratorical purposes, but it is right. It is no use being able to design most complicated alternating current machinery, or being able to explain it with the help of a wilderness of clock faces and several issues of the technical journals, unless the machine, when made, is cheaper than its rivals. Every design, every engineering manufacture, and every piece of engineering is only a question of price. It is unpleasant, perhaps, but it is a hard fact, and we have got to face it. If one of us does £150 worth of work a year, and earns £100, he is efficient; if he only does £90 worth, he is an inefficient machine, and will come to grief. He is like a 90-kw. alternator which takes 100 kw. to excite; though the analogy is not close. If he does £15,000 worth of work and gets £10,000, he is an efficient machine of much larger size, and his efficiency is much more satisfactory to himself. I may mention, in passing, that an efficient man must do more work than he is paid for. This is not always realised. A man who only did what he was paid for would be of no use to the world at large. His efficiency is zero; his consumption being equal to his output. The man who does £15,000 worth of work and gets £10,000 consumes two-thirds of the work himself; so his efficiency is only 33 per cent.; which is very high, even for an engineer.

We see, then, that the business man is the master; the engineer is his good slave; and the raw scientist is not good enough even to be the slave of the engineer; he has no market value at all, except as a teacher of more raw science. The raw scientist will remain at the bottom of the tree until he gets rid of the professional cant which pretends that raw science is pure, or nobler and superior to science as a whole; and the engineer will remain in the middle position as long as he takes the middle view and considers engineering as something superior to money considerations, and as long as he looks down on business and commercial methods. It is cant to profess contempt for money. One of the greatest difficulties in getting on is to find a good opening. At present, especially, times are very bad, and many big incomes have fallen to negligible quantities. The profession, or business or trade seems to me overstocked; but everybody is apt to think his own business overrun. Most of you have probably had, or are having, very thorough college trainings. Unfortunately, you will find that even good college educations are not of high market value.

From the number of applications I receive from young fellows, it seems to be a common idea that consulting engineering is a good thing to begin upon. This is a curious notion. A consulting engineer is supposed to be a highly-skilled engineer, with so much experience that he is an authority. I should have thought at least 20 or 30 years' experience, apart from school and college training, was necessary for a consulting engineer to be worth his salt. But there are various grades of consulting engineer; and I am entirely at a loss to know what the qualifications of the consulting electrical engineer really are. Then still less do I know what the consulting electrical engineer will be by the time you have had 20 or 30 years' experience. At present most of the large towns are electrically lighted, and have their tramways; railways will be electrified by that time, and it is probable the work will be done by their own men. Supervising contractors who are doing wiring will not be much

of a profession in 20 years; and if that is consulting engineering, I do not think so much as 20 years' training is necessary.

In manufacturing work there is the designing of dynamos, motors, transformers, and so on. This was considered high grade work when I was a young man; but now there is not much opening in electrical machine designing. There are many openings to be had in central station work. At present there are also many applicants for every opening. Central station work in a position of responsibility is very anxious; I do not think it is very well paid either. You will find exceedingly able engineers in most of the large town stations; and I am sorry to say their incomes are often very small for men of their technical and commercial ability. The assistants are often poorly paid, especially I think in municipal stations; though I do not know why this should be.

A large number of young men go in for installation work—which sounds as if they started bishops on their episcopal careers—but really means that they do what is in fact electrical plumbing, under an unnecessarily imposing name. There are a great many of them, and they seem to spend most of their time going into and out of partnership with one another, like ions, and sending notices round to that effect. At other times they go bankrupt and send no notices.

At first it is very discouraging to make very little, and the good man has little chance of showing his superiority to the common run. In such a business as engineering a man of first-rate ability may be quite unable to make enough to marry on till he is 30, or enough to be comfortable on until he is 40. An eminent north country engineer, whose name you would all know, though he has been dead some years, said that he did all the hard work of his life for 30s. a week, and when he was well on in life money came rolling in of its own accord. I have reason to believe that one of our foremost engineers, now dead, never made £500 a year until he was over 40.

Though you may not like it, a hard struggle is very good for a young man who has anything in him. There is nothing worse for a young man than to have about £200 a year of his own. He lives comfortably and does not worry; and when he is 30 he wants to marry, and finds he cannot, and it is too late to begin life seriously then. If any of you have this sort of private income, he had better go into partnership in installation work for a year or two, and then begin his business seriously.

I have only mentioned a few of the difficulties in getting on. I am sorry to say there are many more, which you will find out in good time.

CORRESPONDENCE.

Letters received after first post on Wednesday morning cannot appear until the following week.

The Cult of the Marine Engineer.

Why abuse the marine engineer? The machinery of a central station consists of steam plant and electrical plant. The latter comes to hand for better for worse, irremediably fixed for its lifetime with all its birth marks upon it, and a coefficient of efficiency to which it will rigidly adhere.

Not so the engines and boilers. These will do their duty according to their manner of being looked after. If a purely electrical engineer is chief, they may run for 12 lbs. of coal per unit. If a marine man is in charge, the fuel consumption will probably be nearer 4 lbs. per unit.

The qualifications of a marine engineer are set out by your correspondent at page 844, nor are they bad qualifications for securing fuel economy in a central station. Electrical men, fresh from Finsbury and other places, have very little idea of steam practice, and the success of a central station turns very largely on its fuel economy. The marine man may not be *au fait* with electrical theory, but he is usually better fitted to run an electrical station with an electrical assistant than is a purely electrical man with a steam assistant. Electricity has had terrors for the employer, who has hitherto preferred to employ a one year's electrical student rather than an old experienced steam man, and the result has been about 40 million tons of coal gone up the chimney. The proper way to run a station is to put it in charge of a steam engineer, marine or otherwise, and give him good electrical assistants to move the switches about.

It seems to do the marine engineer a lot of good being at sea, and he seems to be something of a gentleman, for he can, we are told, indulge in easy and polite converse with the fair ones. Despite these bewitching hours, he falls not from grace, but will sacrifice the lot and more if only he can stay at home with his wife.

If the writer of "A Tirade" had ever been at sea in an old tramp with patched boilers, a column of bricks to keep up a furnace crown, a cracked cylinder, one blade off the propeller, poor coal, a stinking bilge, half the tubes blind, engines all in pieces, fluted rods, and general old age, he would possibly feel a little more respect for the marine engineer than it at present seems to suit him to acknowledge.

The marine engineer who has done his duty at sea may well be excused for wishing a shore job. There are few better fitted for running steam machinery than he, and were he better appreciated, possibly dividends might improve. The man who has been accustomed to turn out horse-power for down to $1\frac{1}{4}$ lbs. of coal per hour, and has run the Atlantic Ocean through his condensers, may be trusted to be discontented when units cost 5 lbs. and upwards, and vacuum gauges fall towards 20 in., even if caused by bad load factor.

The tirader girds at the marine engineer, who, he says, wrests his job from the trained electrician. This argument cuts both ways. Central station work has been very largely appropriated by students with three years' electrical training, and nothing else, solely and simply on the ground that a power station is more electrical than steam, whereas electricity has but taken the place of ropes, belts, or gears. The man in the street knows that electricity has abolished the steam engine, and this curious idea is at the bottom of the success of the mere boy in grabbing the work of the steam engineer. It is not the marine man who has appropriated the electrician's work; but it is the steam engineer generally who has been dispossessed by men of three years' training, purely because steam is no more!!! It is certainly no more thought of by the electrical chief engineer, who never goes into his boiler house, or, if he does, must have his eyes shut, and who thinks, because he can run a dynamo with 95 per cent. efficiency, there is no use in trying to save in the boiler house. This attitude of mind, if persisted in, will continue to favour the restitution to his own again of the despised marine engineer.

Landsman.

The writer of the article in this week's Review on "The Cult of the Marine Engineer" evidently expects to draw a reply; but I hope that if, with your aid, this matter of the suitability of marine engineers for central stations is thrashed out, it may be done in a good spirit, and without any "odium" being attached to either side.

What is wanted at present is, that the best men for any work should get that work, and any discussion that may help to show who are the best men will do good, and also help to show the best training for such work.

The writer of your article hardly throws any light on this matter. He really states nothing against the marine engineer; on the contrary, he points out much in his favour. Nor, on the other hand, does he advance any reasons to prove the superiority of the electrical engineer as distinct from the marine engineer.

To me, the best plan of settling this point seems to be to first consider what the work consists of, and then we can judge the sort of man required for that work. Having decided these two points, it should not be difficult to settle which are the best men to be obtained at present.

The object of a central station is to take in coal at one end, and turn out units at the other, as efficiently as possible; this is simply "a rough, approximate, rule-of-thumb idea," but I think it states the fact. In order to do this, the station will be supplied with plant consisting of:—Boilers, which may be fitted with any of the various devices for burning the coal and raising steam, engines to transmit the power of the steam to the electric generators, the generators themselves, and the switchboard for controlling the current when generated; each of these divisions of the plant may have many auxiliaries, such as economisers, superheaters, condensers, boosters, transformers, &c., and for our present purpose, I think we may include, as part of the plant, the various men engaged in working the same.

Over this plant there has to be one man to take charge and direct the working of each detail, so that the whole shall give the best possible results. To do this he ought to have a good knowledge of the various sorts of fuel he may be called upon to use, and know how to use each to the greatest advantage; he must know what condition his

boilers and their accessories should be in, how to get them into that condition, and how to keep them in it; he must understand what condition his engines should be in, how to make any alterations that may improve their efficiency, and be able to keep things running by knowing, beforehand, what is likely to give trouble, and so be in a position to *prevent its even giving notice* that it is going to cause trouble. He must understand his generators, he ought to know why they produce the electric current, and what that current should do if properly controlled, also what it may do if not properly controlled; also the uses of the switchboard, and its various instruments, and, as with the rest of the plant, he must be able to perceive the possibility of trouble, and so be ready to prevent its commencement.

He must further understand the human element of his plant, he must not only know what each man's work is, but how that work may be best done, the difficulties that will arise in doing it, and how to overcome them; he must also be able to understand the nature of each man, and, by being in sympathy with them and their difficulties, be able to lead them, and keep all working smoothly together.

He need not know how to design each item of the plant in order that he may know how to run it, although the more knowledge he has, the better for himself and his work; but a good knowledge of how to properly erect the plant will prove very useful in meeting difficulties that will often crop up through faults in the erection of the plant in the first case. His duty, as a rule, is to run the plant supplied to the best advantage, rather than to direct the makers how to build it.

Your correspondent has a rudimentary idea as to the training that a marine engineer passes through, as regards his apprenticeship ashore, but he neglects the fact that the majority will, during those years, attend some of the best science classes that exist, and will be learning the theory of most matters that they will become connected with—even electricity. As for his description of sea life and its experience, it will only provoke a smile from those who have been through it, and were it such as he pictures, there might be fewer seeking to compete with him for central station work.

At sea, as he says, they run with as few stoppages as possible; there are no spare sets there, and the engineer knows that his life and the lives of all on board will often depend on being able to keep running, and consequently, on no work will a man get such a training for detecting trouble in its infancy, and for seeing that all work is done thoroughly, and no chances taken. Also, on no other work will the young engineer get such good training in the use of coal, and it must be remembered that the coal bill is the largest item in most power-producing plants; not only will he get good practical experience in using it, but he becomes acquainted with almost every sort that the world produces, and that this part of his training is efficient, is, I think, proved by the good results obtained in marine practice.

As for the performance of minor repairs and postponement of the heavy work, if your correspondent would go to sea for a short time he might find that he got a bigger share of the heavy work than would suit him, while if he stuck it long enough to obtain that chief's certificate, he would find that there would not be any part of a ship's machinery that he was not thoroughly acquainted with.

As regards the examination itself, let me remind him that there is other knowledge called for than can be learned from books, and I would advise any of your readers who look down on it, to get the syllabus from the Board of Trade and see how much of it they think they could manage. Amongst other requirements he must be able to describe the construction of all parts, and calculate the various stresses they are subject to, answer any question on their management, be able to make a drawing of any part from memory, and correctly dimension it; he must explain everything in connection with the testing and setting of all valves, discern faults from indicator cards, and be conversant with the theory of combustion, superheating, condensing and steam, and he will find his examiner quite ready to tell him to go to sea again and find out anything that he is not sure of.

"Now, in all this, what is there that fits a man for central station work?" asks your correspondent. I should say, *everything*, from the dumping of the coal into the bunker to the coupling that connects the engine to the generator, and a good deal of what is required to fit a man for what goes on beyond that coupling; and it must be remembered that, if we take that coupling as a dividing line, where one shilling can be saved by efficiency on the generator side, 20 can be lost by inefficiency on the boiler side.

Of the management of men the marine engineer will also have gained a good experience. "The supervision of stokers whose caste and nationality are of a miscellaneous character" is unbeatable as a means of studying human nature and how to manage it. Let those who doubt just try.

Now, if we consider the training of our shore electrical engineer, what do we mostly find?

He may have been in some shops as a premium pupil for from one to three years, in which position, in nine cases out of ten, he will have done little and learnt less; I have worked with a good many. He will have spent another two or three years at a technical college, where, at any rate, he should learn how to compete with the marine engineer in "the popular-lecture-engineering style, which is an excellent training for the display of technical knowledge to a borough council." He will also learn, or, at least, is expected to learn, a good deal of the theory of electrical practice; but what will he learn, what pretence has there even been in the past to teach, regarding the practical side of running even the generator itself, let alone the rest of the plant? This he has to learn when he comes to the power station, and did he but show as much anxiety to crawl into a hot boiler flue half full of soot, or to get inside an engine and learn when a bearing is set up so that it will run without causing a shut down, as the marine engineer does to put his nose within sparking distance of the high tension switch, he would find himself able to compete with the marine engineer, and not have to stop out in the cold writing "Tirades."

No doubt we are fast approaching the time when men will be properly trained for this work, but till such men are produced, surely the marine engineer has as good a right to enter a central station and qualify himself to take charge of the electrical portion, as the electrical engineer has to come in and qualify to take charge of the other, and from the £ s. d. point of view, most important side. The field should be open to both, and the best men should have the work.

As for the concluding remarks of the article, the less said the better for the electrical gentlemen, for surely they are the ones who keep the pay poor as it is. Marine engineers as a rule depend on themselves, not on their fathers, and if instead of provoking bad feeling the electrical engineers would meet on common ground, much might be done to improve the status of both; but so far my experience is that the marine engineer demands and gets the best pay.

Neither do I think that a man must of necessity aspire to become a general manager. There is sufficient scope in running a station well to satisfy most real engineers, if only the pay were what it should be.

Marine Engineer.

As the article which appeared in last week's REVIEW under the above title is evidently the work of a disappointed individual, I have no desire to add to his sorrow. The writer, however, in bewailing the inability of men of his stamp to compete in the open market with those who, besides having a thorough knowledge of electrical matters, are masters of the whole equipment in the modern power station, indulges in some quite uncalled-for mud-slinging which for audacity quite eclipses the most telling thrusts in the sensational writings of the celebrated Mr. Pott, of "Eatansville Gazette" fame.

If your correspondent lives long enough, he will, no doubt, in time "condemned well" discover that, as knowledge is not now only the property of the few, the question at issue is simply a case of "the survival of the fittest."

The marine engineer is, without doubt, the man for the position where prompt action, a cool head, confidence, reasoning power, and a thorough practical and theoretical knowledge of the forces of nature and of the strength and adaptability of material are necessary qualifications. He also knows, by reason of his nautical training, his position—

I mean as regards showing due respect to his superiors, and in displaying tact in maintaining discipline amongst those whom it is his duty to keep in line.

In summing up his swashbuckling remarks, the writer of the article unintentionally admits that his Finsbury-trained, Brush Co.-developed and high-tension-excited *confrères* are being crushed out by the "self-trained man." If these Finsbury individuals really possess a fraction of the ability which he (your correspondent) credits them with, then this certainly says something, after all, for the "self-trained man." Moral—"Self-train."

To conclude, I may say I have no doubt whatever that after your correspondent has seen his effusion in print his feelings towards the marine engineer might be more concisely put in verse, viz.—

Though I've belted you and flayed you,
By the living God that made you,
You're a better man than I am,
Gunga Din.

Veritas Vincit.

Information Wanted.

A correspondent asks:—"Who are the makers of an automatic cut-in and cut-off switch arrangement for regulating the voltage at a residence where the storage batteries are 200 yards away—the arrangement to be in place of a man in charge?

"Further, what is the reason, and what could be done in respect to the following:—I have an overhead twin telephone cable wire measuring 40 yards, crossing main street and connecting two shops together on either side with a telephone at each end. I have only used one wire of the cable and worked the instrument on the earth return. I have recently had the opportunity of connecting the other wire in the twin cable to two more instruments ¼ mile either side of the ends of the cable. Strange to say, both owners of the telephones can hear each other speaking quite distinctly, but neither of the bells ring. I have tested the cable, and there is no fault on same, and I can only put it down to induction; is this correct? If so, what remedy can be carried out? It must be borne in mind that the electric tramway trolley wires are up, and only special twin-core cable is allowed."

[The cause of the trouble is obviously induction; the remedy is to put up another cable, and confine each circuit to one cable, doing away with the earth return.—Eds. E.R.]

The name is asked for of the best makers of half-finished "sapphire slabs" and finished "cupped sapphires" for electrical meters. The inquirer would supply the rough Ceylon sapphires himself, and would expect to get the slabs and sapphires cut from them "on commission."

A correspondent wishes to know the name of the actual manufacturers of Howard's High Voltage Wall Plugs (registered design).

Exhaust Silencer.

In reference to the inquiry from Mr. H. Willoughby Lance, and Mr. F. A. Yerbury's reply, I would suggest to Mr. Lance that probably it would not pay him to install a condensing plant for so small a power as 150 H.P. It would be cheaper and far better to put in a small exhaust feed heater for the boiler capacity of, say, 300 gallons. Such a heater, utilising the exhaust steam at, say, 210° F., would give him boiler feed-water at about 206° F., and would not only do away with the noise, but would also save considerably in coal consumption. The heater could easily be carried on the substructure or on two small brackets, and would only cost about £60 to £100 complete.

Mr. Yerbury seems to forget the possibility of a considerable percentage of oil being contained in the condensed steam, which would either have to be separated or treated, thus multiplying the auxiliary plant and cost generally, before it would be fit for boiler feed.

John A. Smeeton.

London, S.W., *November 18th*, 1904.

Theatre Dimmer.

With reference to your notice and Messrs. Moy's letter in regard to the "dimmers" used in this place of entertainment, I am certainly employing a portion of the regulating gear recently removed from Drury Lane Theatre for use in connection with the Wirt dimmers. The switchboard I have entirely re-arranged, considerably added to and improved—originally sufficient to control the lights for so large a theatre, it plays only a part in the electrical arrangements, which are necessarily most intricate for such effects as Mr. Maskelyne produces, an ordinary stage gear being quite inadequate.

Edward Morehen.

London, W., *November 21st*, 1904.

Cost of Production.

Mr. Byng's letter of the 16th inst. is interesting. If it were less academic and more precise it might even be valuable. Confining one's attention solely to the electrical industries, can Mr. Byng give the volume of the respective internal electrical markets of Great Britain, Germany and the United States? How many millions' worth of electrical machinery imported from abroad has found its way into our central stations, and how does this amount compare with the value which our own manufacturers have supplied? By what margin have these orders been lost? If Mr. Byng will leave generalities and obtain the compilation of such figures as those I have indicated, he will render a great service to the general community, but possibly a dis-service to the cause he has so strongly at heart.

Turris.

Nernst Lamps.

I should be very interested to hear the opinion of users of Nernst lamps in other towns asto their reliability, and as to what trouble has been found in maintenance of burners.

Contractors in particular I would like to hear from:—

1. Whether they find the new type ¼-ampere burner an improvement, or otherwise, on the earlier one.
2. Whether polarity makes any difference to the life of burners.
3. Can they satisfy their customers with the maintenance costs of Nernst lamps?

Gloucester.

Lead-Covered Wires.

In reply to the letter of "P. Y. C." appearing in your last issue, I am afraid I cannot derive the benefit I should like from this letter. Seeing that I did not mention the faulty construction of the boxes, &c., implying the presence of water to cause the trouble in the cable, I think these matters may be left out of the question; as to the drawing-in of the cables by "capable and experienced electricians," that also may be omitted, as also the insulated mouthpiece. The last time these cables were reinstated, I personally superintended every piece drawn in, the drawing was done by capable and experienced electricians, through insulated mouthpieces, and everything was done to ensure a good insulation resistance, that could be done without actually putting in new cable throughout. I am very much afraid that my letter was misunderstood; the fault lay in the cable, and my desire is to know if other people meet with the same experience as my own.

In reply to the letter of "A. H. M.," also appearing in your last issue, I take this opportunity of thanking him for his suggestions as to the joints in the cable, and beg to inform him that the method he describes is the method employed. The joints are first bound with rubber strip, then a covering of prepared tape, they are then laid in a lead box, which is of sufficient length to enclose about 1½ in. of the lead covering of the cable at each end, the whole being filled with a mixture of bitumen and pitch. I have broken these boxes in various places and have always found the joints good and dry.

The action I make mention of is not electrolytic, it is more of a corrosion; the lead cover becomes quite pitted, and crumbles when handled. When I withdrew these cables the

last time, I cut out the worst pieces, showed them to a leading electrician in London and asked his opinion. He said he had never seen anything like it in all his experience. I am sorry these pieces have been lost, as they have proved a source of interest to users of lead-covered wires.

T. H. Banks.

London, W., *November 22nd*, 1904.

The Electro-Harmonic Society.

With reference to the letter from Mr. A. H. Allen, which appeared in your issue of the 18th inst., I beg to inform you that at a meeting of the Executive Committee of the Electro-Harmonic Society held on the 16th inst., it was resolved :—

"That chairs may only be reserved up to 10 minutes to eight o'clock, after which time any vacant chairs may be occupied."

W. E. Lane,
Hon. Secretary.

123, Cannon Street, E.C.,
November 23rd, 1904.

Combustion and Stoking.

In connection with your last week's editorial on Sir Oliver Lodge's recent address at the Birmingham University, you observe that :—

"He condemned water-tube boilers as unsuccessful, because of the cooling effect of their tube surfaces, which make contact with the gas before it has had time to mix with air and burn at a sufficient temperature."

This appears to us a very wide and sweeping statement, and it would interest us to know how this affects boilers which are not of the water-tube class, such as vertical boilers, Lancashire and Scotch marine boilers, where the (water covered) plate surfaces of these furnaces are by no means remote from the fire. Now, in any well-designed water-tube boiler there is a better means of maintaining the temperature than in the foregoing boilers, due to the brickwork surrounding the fires, as well as to the comparative remoteness of the front water tubes. We can claim that the Stirling boiler, at least, has this advantage.

We might add, that uniformity of feeding the fires with fuel, say, by a good automatic stoker, instead of the barbarous methods of filling up the boiler furnaces by hand-firing, would bring us nearer the real solution of this question of coal combustion. We might also add that there is no difficulty in proving that in a well-designed water-tube boiler, the temperature of the combustion chamber is higher than that of the ordinary tank boiler.

The Stirling Boiler Co., Ltd.

Motherwell, *November*, 22*nd*, 1904.

[The effects of cold surfaces about a furnace are, of course, equally pernicious in shell as in water-tube boilers. The latter suffer more than shell boilers, because a larger proportion of their heating surface is in close touch with the furnace. The trouble to which, we take it, Sir Oliver more especially referred, was the want of air mixture which takes place where the furnace of a water tube boiler is so arranged that the gases from the fuel rise in vertical lines and pass immediately between cold tubes forming about half the total surface of the boiler.

In shell boilers the furnace crown forms a small fraction of the total surface, and the form and arrangement of the furnace is correct, so that such boilers are more easy to work smokelessly, or with little smoke. But the water-tube boiler can more easily than the shell boiler be fitted with a furnace of correct form and material. That so few are thus fitted is not so much the fault of the boiler as of its makers, users or sponsors.

We are not quarrelling with water-tube boilers as such, nor did we understand that Sir Oliver was doing so. Our fault-finding is with the apathy that produces bad furnace arrangements. We are glad to find that the Stirling Co. agree with us in some points, especially as to firebrick linings and further removal of the heating surfaces.—Eds. E.R.]

["Pity the Poor Beggars."—A correspondent has drawn our attention once more to the methods which are adopted in some parts of the country for getting together the necessary funds for providing an annual dinner, supper or entertainment for the employés of municipal departments. We have dealt with this subject before, and we can see no earthly reason why every manufacturer or trader who supplies half-a-crown's worth of goods should be asked to provide these poor employés with an annual "treat." Our correspondent's case is an example of the ridiculous extent to which these requests are made. He has supplied a certain corporation with one article in the whole of his experience, costing less than a sovereign, and has supplied nothing whatever during this year, yet he is again, as last year, annoyed with this presumptuous begging letter accompanied by a list of subscribers to last year's fund. Really, dignity and independence are at a discount among such employés, and the cringing attitude which allows them to beg for charitable contributions in this despicable manner is utterly contemptible. We wonder what is the effect upon the giving out of orders if the manufacturer fails to subscribe? But—enough!—Eds. E.R.]

[A correspondent, who forgets to state his name and address, writes asking for information as to the actual results obtained by engineers who have tried Mr. A. B. Mountain's suggestion, that an oil engine and dynamo running without attendance, be used in place of accumulators for the night shift in small electricity works.—Eds. E.R.]

LEGAL.

British Accumulator Co. *v.* Kramer.

In the Chancery Division of the High Court of Justice on Tuesday, Mr. Justice Kekewich had before him an action by the British Accumulator Co., Ltd., and the Allgemeine Accumulatorenwerke Actiengesellschaft *v.* Arnold Kramer, Parliament Mansions, Westminster. There was also a counter-claim by Mr. Kramer against the plaintiffs.

Mr. P. Ogden Lawrence, K.C., and Mr. Wilkinson appeared for the plaintiffs; and Mr. Stewart Smith, K.C., and Mr. H. E. Wright for the defendant.

Mr. Lawrence, in opening the case, said it was an action against a former manager of the plaintiff companies arising out of acts done by him since the determination of his agreement for employment. Since the determination of the agreement in December last year, Mr. Kramer purported to act in the name of his principals, and refused to give up possession of the office and papers. One of the questions his Lordship would have to try would be whether the plaintiffs were entitled to an injunction to restrain the defendant from using the names of his principals and from opening letters which came to the plaintiffs, and for an account of the moneys which he had received during the period of his managership. The counter-claim was brought for wrongful dismissal. Plaintiffs submitted that defendant determined his employment, or, at all events, it was determined by mutual consent. If it were held that plaintiffs did dismiss him, they then pleaded that they were justified in doing so. Plaintiffs' contention was that defendant having been employed under an agreement, he tried to exact better terms after he had established himself in England, and used as a leverage the fact that he was not going to devote himself to the affairs of the company unless his salary was raised, and he was given more extended powers under the agreement. Owing to this intolerable state of things, something had to be done to get rid of the defendant. The German Co. carried on business at Vienna as manufacturers of electric accumulators. It was afterwards thought advisable to establish a branch or agency in England. It was in connection with that agency that defendant was employed, and in November, 1903, the agency was formed into an English Limited Co. The terms of defendant's employment were written out and signed in German, and the document was dated October 3rd, 1902. It was handed by defendant to the Vienna Co., and contained the following terms:—"I undertake the management of the establishment you wish to open in London for the sale of accumulator batteries. You give your consent that I keep on as hitherto the agency of the electrical works in Rheydt, but I will not take over any other agency or obligation. I receive an annual salary of K6,000, say, 6,000 crowns in monthly instalments, payable at the end of each month. Further, I shall receive 10 per cent. of the net profit of the London business after the annual balance-sheets shall have been revised by you. I have to obtain your directions with regard to the London work and to adhere to them. It can only be decided at a later period whether this London establishment shall be an individual, commercial, or agency company formed. I shall have the title of manager thereto, and begin my duties to-day. The business expenses of the London office shall be kept as moderate as possible, and I shall, as regards

larger amounts, have to ask for your consent in each case. As regards smaller amounts, I shall bring these to your knowledge later on. It is understood that the London agency will get the accumulator plates exclusively from the works at Raab, who will charge the London business with only the material, wages and general expenses, and no profits, so that the accumulator plates shall be as cheap as possible for the London agency. This agreement cannot be cancelled by either party for 18 months, and after that by six months' notice by either party." Immediately on the signing of the agreement, Mr. Kramer came to London and took offices for the purpose of carrying on the agency. The learned counsel thereupon read a large number of letters which passed between the directors of the Vienna Co. and the defendant, and submitted that the plaintiffs had from the first pointed out to the defendant that his agreement contained no stipulation that he would be appointed managing director of the British Accumulator Co. On June 13th, 1903, the defendant wrote, asking the Vienna Co. to write him in a more polite style, and stating that he should not undertake the extensive and difficult work in London for £250. In order to meet the necessary requirements of living in England, he wanted £600 to £700. In another letter, he stated that he was ready to fill the post of secretary as well as managing director of the British Co., and stated that, unless the salary he stipulated for was given, he should have to consider the plaintiffs' agency as a secondary matter. On July 24th plaintiffs wrote that they had no intention of altering their relations with the defendant, or of making the conditions more favourable to him. They stated that they had come to an agreement with him for a certain period, and they expressed surprise that he should approach them with other propositions. In addition to his salary, defendant was to receive 10 per cent. on any profit in the London business. The plaintiffs' letter concluded:—"The custom all over the world is, first sow, and then reap. We recommend you to sow diligently, and the harvest will not be missing." The learned counsel, proceeding, pointed out that there were heavy contracts running with certain Corporations in England, and that they would not pay the plaintiffs anything for the supply of accumulators till defendant assigned the contract to plaintiffs. The Borough of Radcliffe would not pay the plaintiff companies a penny till the contract was assigned by Mr. Kramer to them.

Mr. Stewart Smith: We have told the Borough of Radcliffe that they may pay to the British Accumulator Co. On December 21st, 1903, the defendant wrote to the Vienna Co.:—

"In consequence of the formation of the British Accumulator Co., Ltd., behind my back, without my knowledge and consent, and as I must decline to put myself under the orders of somebody else in London in fulfilment of my position, and to suffer a diminution of my position as regards the exercise of my functions, title, &c., and as you have broken the agreement for several months past, as shown by the correspondence, I regret to be compelled to inform you that I consider our agreement of October 3rd terminated. In consequence, I claim damages as follows: My salary in arrear as per agreement up to October 1st, 1904; damages as per agreement for loss of part profits, and for organising the business, for having obtained for you two Corporation batteries, and for having introduced you in England. These damages I estimate at £500. As soon as we come to a friendly arrangement concerning the amount to be paid to me, I am ready to hand over in order, my position, the office, inventory, &c."

On the 22nd of the same month, the Vienna Co. wrote determining the agreement. The two letters crossed in the post, and it might, therefore, be said that the employment was determined by mutual consent. Counsel proceeding, asserted that defendant refused to hand over the books of the office, and proceeded to trade as the British Accumulator Co. In January last, proceedings were taken, and defendant gave an undertaking until the trial of the action, or further order, not to carry on or purport to carry on business under the style or title of the British Accumulator Co., or in any way to make use of that name for the purpose of his business, and to forward unopened any letters addressed to the British Accumulator Co. to the manager or secretary of that company. Plaintiffs then got possession of the office and letters, and they now asked that the undertaking should be made perpetual, or an injunction granted. Defendant counter-claimed for a balance of account due to him, but plaintiffs contended that there was a balance due to them. The plaintiffs also asked a substantial sum for the trouble they had been put to in removing the defendant from their office in London.

Mr. Stewart Smith said his defence was that Mr. Kramer was engaged as manager by the Vienna Co., and that he acted for the Vienna Co. as manager until Mr. Von Gerson came over with power of attorney, and endeavoured to supersede him in his functions. Mr. Von Gerson told defendant that no act was to be done, and no letter was to be written which had not his sanction or signature. Defendant had always been kept short of money by the Vienna Co. Matters became so acute that Mr. Kramer wrote pointing out that there had been a breach of contract by the Vienna Co., and that he could not transfer his services to a company which had then only seven shares taken. The letter of December 22nd from Austria was a determination of the agreement by the Vienna Co. Mr. Kramer was entitled to remain in the offices in London, because they had been taken in his name, and he was responsible for the rent. On receiving proper indemnity he was willing to give up the office and the papers. Mr. Von Gerson, during Mr. Kramer's absence, had attempted to get into the office to remove furniture, and the landlord said he would not allow it until the rent was paid, so matters remained till January 22nd, when an agreement was come to, and Mr. Kramer gave up possession of the offices, books and furniture. He denied that he had been carrying on business as the British Accumulator Co., or that letters addressed to that company had been opened by him since last January. The learned counsel further stated that he would argue that Mr. Kramer was never the servant of the English company under the contract made in Vienna. He was not bound to serve that company unless a new contract had been entered into.

Mr. Felix Von Gerson was afterwards examined on behalf of the plaintiffs. He said he had been instructed by the Vienna Co. to try and arrange all matters concerning Mr. Kramer. After the agreement was determined he went to the office of the British Accumulator Co. to take possession. He found Mr. Kramer out, and when he lifted a bundle of papers, the lady typewriter jumped from her seat and called the landlord's agent, who told him that he had orders from Mr. Kramer to allow nobody to interfere with the property. On a later day, when witness called at the office, Mr. Kramer showed him to the door, saying, "You have nothing to do here. This is my office." In January last the witness received from defendant a number of letters addressed to the British Accumulator Co., and the greater part of them had previously been opened.

Cross-examined, Witness stated that he was chief engineer in London, of the Railway Carriage Works of Vienna. These works belonged chiefly to the shareholders of the Accumulator Co. He had orders from Vienna to counter-sign all orders issued by Mr. Kramer, as well as correspondence. The British Accumulator Co. was registered on the instructions of witness, who was one of the directors. Mr. Kramer went abroad in December last, but did not ask permission to do so.

Mr. Wilson, a customer of the plaintiff company, who had contracted for the supply of batteries at Rickmansworth, spoke to being asked for payment of an account, and to Mr. Kramer informing him that the new British Co. had nothing to do with the contract. Witness had since paid to the company everything due under the contract.

Alice Von Munn, a typewriter, who had been employed by the defendant, gave evidence as to typewriting letters on Mr. Kramer's private paper. The letters were addressed to three firms who were competitors of the Vienna Co.

Cross-examined, Witness said the letters asked particulars of the terms on which the manufacturer would supply electric accumulators in England, and in one case Mr. Kramer asked the firm if they were willing to have a branch in England. The letters were written between May and August, 1903.

This closed the plaintiffs' case, and the hearing was adjourned.

On hearing being resumed on Thursday, Mr. Stewart Smith submitted that when Mr. Von Gerson was to be entitled to sign every letter, sign every order, and control every minute part of the business, it was impossible in practice, for Mr. Kramer to make the 10 per cent. out of profits at all. The action was improperly brought for an injunction and damages against the defendant. It was not until December 28th that Mr. Kramer received the letter from the Vienna Co. dismissing him. On that day he removed the word "Limited" from the door of the office, and between that date and January 1st he sent all letters addressed to the British Accumulator Co. to the plaintiffs' office in Parliament Street. The reason some of the letters were opened was because he believed them to contain invoices for goods for which he was liable. The invoices were necessary in order to enable him to make up his monthly accounts to his principals. On January 4th the name of the British Accumulator Co. was entirely removed from the door of the office. There was no evidence that the defendant had attempted to trade under the name of the British Accumulator Co. After the undertaking given by the defendant, the proceedings on the part of the plaintiffs were entirely unwarranted. Mr. Kramer had due to him a large balance from plaintiffs. The letter written by Mr. Kramer to the Vienna Co. in December, was not in effect a resignation of his position, but a protest against the treatment he had experienced, and a statement that the conduct he complained of had released him from the contract. Even supposing the Vienna Co. had a right to transfer its business to the company it created, it could not transfer the services of Mr. Kramer to that new legal entity without Mr. Kramer's consent.

On the conclusion of the counsel's arguments on behalf of the defendants,

His Lordship gave judgement: He thought on the proper construction of the agreement, Mr. Kramer was to have no voice in the decision of whether the London establishment was to be an individual, commercial, or share company. Mr. Kramer had proposed that he should be managing director of the London concern, and had even suggested who should be his colleagues on the board. Mr. Kramer, however, was not accepted as managing director, and some time later the Vienna Co., employing their own solicitors, had a new memorandum prepared, and procured the registration of the British Accumulator Co., Ltd. Defendant was not asked to be a signatory to the memorandum. There was no doubt from the correspondence that the Vienna Co. thought Mr. Kramer would continue as manager of the new limited company at the same salary as formerly. He did so at first, but later, disputes arose between himself and the Vienna Co. as to his position. His Lordship could not say that Mr. Kramer had been wrongfully dismissed, having regard to the letter he wrote on December 21st stating that he considered his agreement at an end. With regard to opening letters after ceasing by his own act to having any connection with the company, Mr. Kramer had gone beyond his rights. It would be wrong to grant the company any substantial damages for what defendant had done after he ceased to be their servant, but the company were entitled to have a verdict in their favour to show that they were right in the matter. Defendant's counsel had admitted that he did not resist either of the injunctions claimed,

and as regarded the tenancy agreement, no question now arose. So far as the account asked for by the counter-claim, had relation to damages, it failed, but defendant was entitled to an account in order that he might have re-embursed any moneys he had paid on behalf of the company. Defendant was ordered to make assignments at plaintiffs' cost of any contracts he had entered into, and which had not yet been transferred to the company.

THE ATTORNEY-GENERAL *v.* THE URBAN ELECTRIC SUPPLY CO., LTD.

THIS case came before Mr. Justice Joyce in the Chancery Division on Tuesday last, on an application by the defendants that the injunction granted by his Lordship on August 3rd last, might be stayed until the expiration of the present session of Parliament, or for such other period as might be thought just. The plaintiff had, in August last, applied to his Lordship for an injunction to restrain the defendant company from supplying electric current for power, light, or other purposes outside their area, and also to prevent them from breaking up the streets in Weybridge, for the purpose of distributing electric energy outside the district. The Attorney-General contended that what had been done by the defendants in supplying the Walton Urban District Council with energy was a breach of the Weybridge provisional order. The defendants, on the other hand, contended they had a right under the order to supply Walton as a local authority having power to light its own district. In the result, his Lordship held that the plaintiff was entitled to an injunction to restrain the defendants from supplying energy outside the area of supply specified in the Weybridge order, but suspended its operation for a certain period.

Mr. Younger, K.C., and Mr. Clanson appeared in support of the application, and Mr. Hughes, K.C., for the Attorney-General.

His LORDSHIP asked why the defendants did not go to the House of Lords.

Mr. YOUNGER said that the defendants did not want to do that, he thought. The position was that everything might be put right by an Act of Parliament. On August 3rd his Lordship had intimated that the District Council had no cause of action.

His LORDSHIP said he did not say that. What he said was, that if the defendants were unreasonable, it was always in the power of the District Council to go to the Attorney-General.

Mr. HUGHES, K.C., for the Attorney-General, opposed any further stay. The defendants were breaking the law.

His LORDSHIP said he would give the defendants a further stay till January 12th next. He asked Mr. Hughes if he wanted his costs then.

Mr. HUGHES replied that he did not, but he asked that they should be the plaintiff's in any event.

His LORDSHIP: Yes.

Mr. YOUNGER suggested that the parties should dispense with pleadings.

His LORDSHIP suggested that the defendants should treat the motion as the trial.

Mr. HUGHES said the plaintiff could not dispense with pleadings. I ask that as the defendants have got these terms, they are only to supply existing customers.

His LORDSHIP: I can't do that. Why should I inconvenience the customers?

NATIONAL ELECTRIC CONSTRUCTION CO., LTD., *v.* METROPOLITAN BOROUGH OF POPLAR.

IN the High Court of Justice on Tuesday, an application was made to Mr. Justice Kekewich to postpone the hearing of this case, which is down for trial before his Lordship, sitting as Judge of the King's Bench Division.

All parties being agreed, his Lordship consented to the trial being postponed for a week.

SHEFFIELD & SON *v.* STOREY.

AT Rhyl County Court recently, Judge Sir Horatio Lloyd delivered judgement in the case of Messrs. Alfred Sheffield & Son, ironmongers, Rhyl, against Mr. W. J. P. Storey, lessee of the North Wales Hydropathic, Claremont, Rhyl. According to the *Liverpool Daily Mercury* the action was brought to recover £93 5s. 6d., balance of the sum of £260 13s. 6d., claimed by the plaintiffs for work done and materials supplied in the installation of electric light and bells in the defendant's premises. The work was done under a contract entered into between the parties, plaintiffs' original tender being £229. Plaintiffs alleged that defendant had informed them that Mr. Lewis Evans had tendered to do the work for £200, and that they had been induced by that statement to enter into a contract for £200.

The jury found that the defendant did untruly make this representation to the plaintiffs, and they found a verdict for plaintiffs for £76 19s. 7d.

The defendant then moved for judgement on the ground that it was not competent for the plaintiffs to ignore the contract under which the work had been done, as the position of the parties had altered, and that any such representation, as the jury had found to have been made with reference to Lewis Evans, was irrelevant to the issue.

The judge was of opinion that, if any action was maintainable, it should have been one for deceit. In matters of this kind, the tradesman was surely the best judge of the terms upon which he was prepared to do the work. The statement that someone else had offered to do it for less money would be a gratuitous one, on which, in the case referred to, it was "folly to rely." He must enter judgement for the defendant, but, having regard to the finding of the jury, it would be without costs.

BUSINESS NOTES.

A New Electric Fittings Showroom.—At their new electrical showrooms Messrs. Falk, Stadelmann & Co. have been able to secure an air of repose, which renders the task of the purchaser an easy and pleasant one, carefully furnished and luxurious saloons being provided, in which are carefully shown their special designs of fittings. The additional showroom in Farringdon Road, E.C., has enabled Messrs. Falk, Stadelmann & Co. to effect a great

FIG. 1.

improvement, and contractors will take note that another showroom is placed at their disposal, when private clients require to inspect fittings. Every fitting stands out clear and distinct. Large plate-glass cases contain the better class of fixtures, in crystal, silver, bronze, &c., and in addition to furnishing the large interior, these

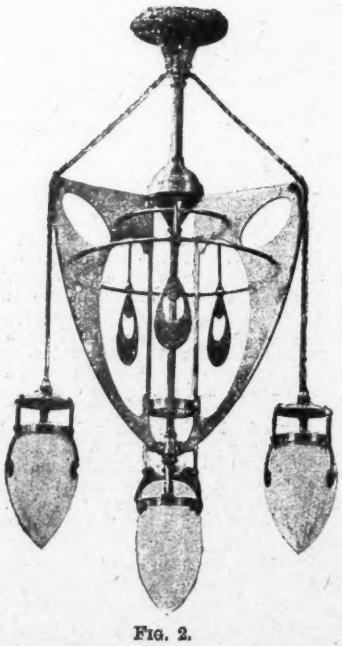


FIG. 2.

cases serve as divisions of the room, allowing displays of goods of different styles. A large number of statuettes in bronze, compo bronze, faience, &c., are on show, and we understand that the company's Continental House is in touch with all the centres on the Continent from which these examples were obtained, which places them in an excellent position for dealing with the large trade done in high-class Continental goods of the kind named. Some excellent examples of cast work in the Art Nouveau School, and several good

designs in cut crystal suspensions are on view, and these and the numerous illustrated designs are all shown under light. On the opposite page we illustrate two designs. Fig. 1 is a table standard in real bronze, finished natural colour. The bow is of cast-metal with chased relief picked out in antique green, and decorated on the face with imitation opals. The light is enclosed in a hammered bronze shade, inset with translucent glass jewels. Fig. 2 represents a cast-brass four-light semi-ceiling fitting in the Art Nouveau School, polished and pale lacquered. This is a graceful design though simple in character.

Electrical Machinery for Collieries.—Messrs. Ernest Scott & Mountain, Ltd., of Newcastle-on-Tyne, have recently secured an order from the Bedminster Coal Co., Bristol, for a complete installation, consisting of a 300-I.H.P. steam engine and electric generator, and a complete equipment of electric motors for driving the underground haulage, pumps, &c. The machinery throughout will be of the three-phase alternating current type, as it is proposed, at a later date, to add considerably to the installation, and to drive the whole of the collieries under the control of the Bedminster Co. from one central station; as some of the pits are a considerable distance away from this station, the utilisation of three-phase current will have great advantages, as the pressure can be very readily increased for the long-distance circuits. For the Wiltwick Colliery, near Leicester, Messrs. Scott & Mountain are also to carry out extensions to the electrical pumping machinery which they installed a few years ago, the order consisting of one of the firm's three-throw horizontal pumps, with electric motor, cables, &c., this pump being constructed to deliver 30 to 40 gallons per minute against a vertical head of 500 ft. For one of the leading collieries in India the same firm have in hand one of their portable three-throw pumps and electric motors mounted on trolley bedplate, for working against a 1,200-ft. head. Messrs. Scott & Mountain also have an order in hand for extensions to the electrical machinery which they supplied to Messrs. North's Navigation Collieries, Ltd., a few years back, these extensions consisting of a steam engine of 450 I.H.P., together with direct current generator and two sets of large in-bye main and tail haulage gears, each driven by electric motors of 100 effective H.P. These haulage gears will be fitted with the firm's special type of friction clutch. For the Wallsend and Hebburn Coal Co. the same firm has just received an order for one of their three-throw pumps, fitted with three rams, each 14 in. diameter, having a stroke of 18 in., and delivering 1,000 gallons per minute against a head of 180 ft.; this will be driven by ropes from one of the firm's direct-current electric motors of 100 effective H.P., the current for this motor being taken from the Supply Co.'s mains. We also understand that Messrs. Scott & Mountain's new type of coal cutter is making considerable headway, and that they have orders in hand for several machines for different parts of the United Kingdom.

Electric Timing Apparatus.—This apparatus, which we describe below, has been designed to accurately time by means of an ordinary stop watch, and it is being manufactured by Messrs. Wharam & Borland, of Leeds. The apparatus illustrated, fig. 1, is composed of an electro-magnet enclosed in a metal case out of which protrudes the lever X which depresses the key; when the watch is placed in position the micrometer screw, Y, adjusts the watch with regard to X. When the apparatus is connected to a battery the first contact will start the watch, the second stop it, when the time recorded is read and noted; the third contact will re-set it, or it may be re-set by pressing the depressor X with the finger. The switches or contactors, figs. 2 and 3, which are shown in the "on" and "off" positions, have been specially designed to

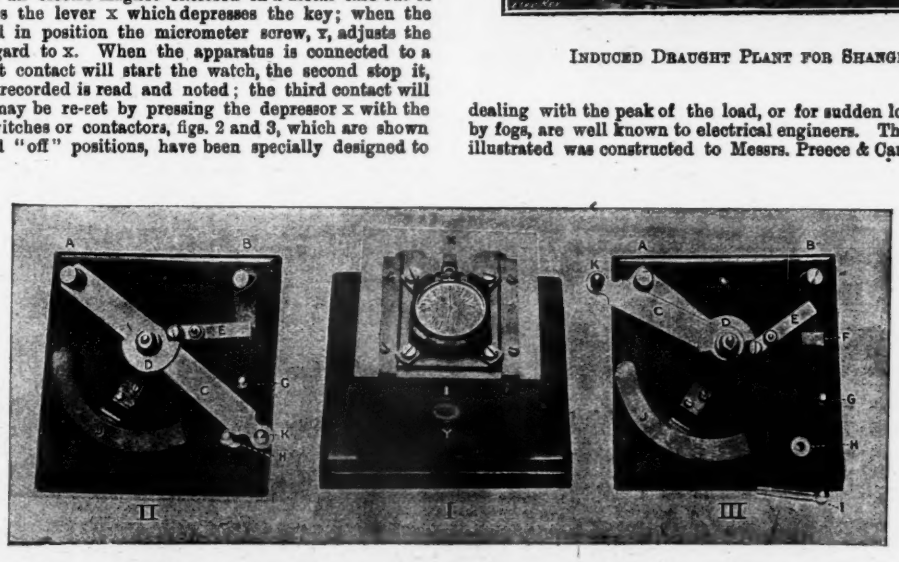
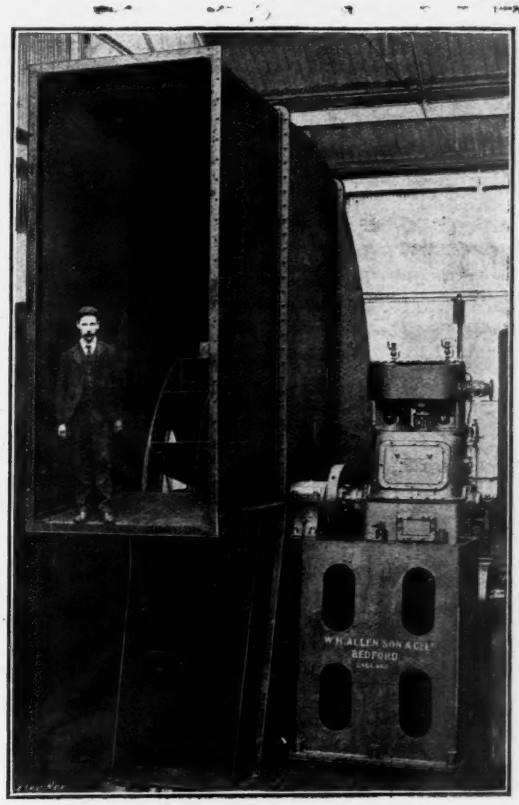


Fig. 2. Fig. 1. Fig. 3.

Electric Timing Apparatus.

time motor trials. At the starting and finishing points of the road a wooden stake is driven in the ground on either side of the road. On one side the switch or contactor is screwed to one of the stakes, and a thread is attached to the lever at K and stretched across the road to the other stake. The + of the battery is connected to the terminal A; directly the thread is broken by a passing motor the lever C flies over the contact J by the action of a spring, and the current flows through lever C to contact J and through the subsidiary switch E to terminal B, thence to the timing apparatus and back to the battery, the circuit being thus completed and the watch started. The same operation is repeated at the finishing end and the watch is stopped. When resetting the contactor the watch would be stopped, but to obviate this the subsidiary switch E is provided, as will be seen in fig. 2 in the "on" position. E is in contact with terminal B, but as soon as the switch C leaves the contact J the cam D knocks the switch E off, and it is only re-set in the same manner when the switch C has again left the contact J. The plug I is then inserted in the hole H, and kept there until the thread has been properly secured.

Steam-Driven Induced Draught Plant.—We illustrate in this issue a large steam-driven induced draught plant recently constructed by Messrs. W. H. Allen, Son & Co., Ltd., of Bedford. The advantages of fan draught in central stations for



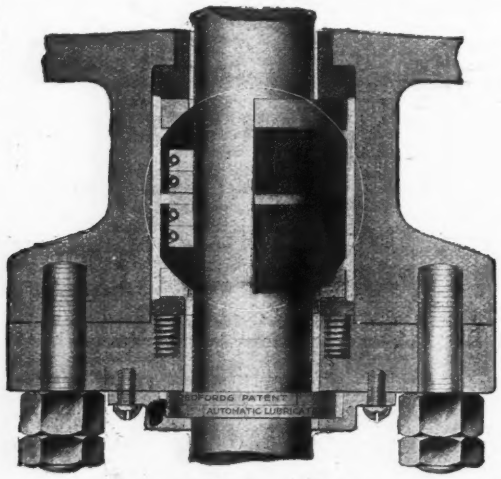
Induced Draught Plant for Shanghai.

dealing with the peak of the load, or for sudden loads brought on by fogs, are well known to electrical engineers. The particular fan illustrated was constructed to Messrs. Preece & Cardew's specification for use in connection with an installation of Messrs. Babcock and Wilcox's boilers in Shanghai. These boilers are of this firm's well-known marine type, each having a grate surface of 1100 sq. ft. The fan runner is constructed of steel plates, and is 10 ft. in diameter. The fan is capable of maintaining a vacuum in the suction of 1¼-in. water gauge, when passing 122,000 cb. ft. of gases per minute at a temperature of 600°. The fan is driven direct by one of Messrs. W. H. Allen, Son & Co.'s two-crank two-cylinder enclosed compound engines, fitted with forced lubrication, and capable of developing 60 B.H.P. when running at a speed of 250 r.p.m. The engine is specially designed for continuous running

with a minimum amount of attention. The fan runner is supported by a large bearing fitted with automatic ring lubrication and provided with water circulation, and the fan bearing and engine are mounted on a massive cast-iron base, so that the whole is self-contained, and only very simple foundations are required.

A Large Dialite Cable.—The St. Helens Cable Co., Ltd., of Warrington, have recently turned out in one length a very large Dialite cable for a colliery in South Wales. This cable, of which we have received an illustration, is supported at two points down the shaft by means of special safety grips made by the company, and weighs 10½ tons. The working pressure is 2,200 volts. The area of each of the three cores is ·4 sq. in., which, according to the new Home Office rules, gives the cable a power capacity of 1,000 KW., which is, according to the company's experience, an unusually large power to entrust to one cable in work of this description, and shows a gratifying confidence in the insulation, which is their well-known Dialite bitumen. A unique feature of this cable lies in the fact that each core is insulated with bitumen, no paper whatever being used. In some other factories where bitumen cable is made, we are informed that when turning out a three-core, each core has to be insulated with paper, the three cores being merely protected when laid up with a layer of bitumen, making the cable liable to faults from water. The bitumen may be too soft to withstand the mechanical pressure exerted by the cores due to the strain when being laid up. The present cable is protected by two layers of galvanised iron wires, and served overall with jute and preservative compound, making a total diameter of 4 in. In suspending, the special grips are attached to the armouring wires only, no mechanical strain being put either upon the insulation or upon the copper conductors. No sealing boxes are being used, as such are unnecessary with this class of cable, the open end of which, it is claimed, could lie in water for any length of time and be none the worse for it. The cable was made to the order of Messrs. D. Selby Bigge & Co., Newcastle-on-Tyne, for the Glamorgan Coal Co.

Metallic Packing for Working at Various Pressures and High Temperatures.—The increased steam pressures, high superheat and high piston speeds of to-day have rendered the use of pure metallic packings an absolute necessity. Many different designs have been brought forward; two of the principal ones are those that pack against the steam and the steam setting type. Those that pack against the steam consist of conical soft metal rings which are pressed against the rod, the rings being forced into a solid cup by a heavy spring or springs, which must have a very excessive pressure to overcome the steam pressure multiplied by the difference in



Spherical Metallic Packing.

area of the rod and the clearance space, which is left for vibration or for the rod to run out of alignment. This pressure is often so excessive, that it forces the soft metal rings through the cup, so that it needs very little imagination to conceive what friction exists. The steam setting types admit steam into the packing case, which is bolted to the cylinder cover. They are generally of a complicated nature, since they comprise a large number of springs, segments and rings. As the packing is forced to the rod by steam plus spring pressure, the friction on the rod increases proportionally with increase in boiler pressure; not only this, but the fact of admitting steam in the packing case at each stroke of the piston is an additional loss.

The most suitable packing to meet the different conditions is the one that has a very light constant pressure on the rod, and is not affected in any way by increase of boiler pressure; it must be constant throughout, whether for high, intermediate, or low-pressure rod. Many so-called metallic packings that met with success until a few years ago are now giving much trouble; on the more modern type of engines with their increased piston speeds, steam pressures and superheat, they are not only wearing out more rapidly, but causing heating of rods, which is a proof of excessive friction. As superheated steam has been proved to be advantageous and conducive to great economy, the metallic packing should be capable of withstanding any degree of temperature likely to be required, therefore the use of white metal should be discarded at once, and steam should not be admitted in the stuffing box.

The Spherical Metallic Packing and Engineering Co., of Harpurhey, Manchester, have introduced a purely metallic and entirely self-adjusting packing. It does not require a stuffing box, but can, with equal facility, be fixed in existing boxes. If the rod is out of alignment, the spheres move freely one within the other in the form of a ball and socket joint, so that the special bronze anti-friction metal packing pieces endure no stresses from this cause. The illustration shows the packing fixed inside an existing stuffing box. When fixed outside it is fully open to view, and can be seen yielding gently to every motion of the rod, and at the same time rotating under all conditions of pressures, thus proving absence of undue friction. Steam cannot enter the stuffing box, and as no condensation takes place no drains are required, as in the steam-setting type of packing. The only pressure on the rod is that exerted by light springs round the bronze anti-friction metal pieces; this is only ·5 to 1 lb. per sq. in. of surface contact, and is the same under all loads and steam pressures. The pressure per sq. in. of surface contact, on piston rods packed with the steam-setting type of packings, would be as follows:—With an initial steam pressure at the engine cylinder of 180 lbs. per sq. in. and a usual cut-off, we might get, say, 105 lbs. pressure per sq. in. of surface contact during the whole travel of the rod. To this must be added the pressure exerted by steel springs, with which all these metallic packings are fitted, and which is equal to 2·5 lbs. per sq. in. The total "average" pressure of the packing on the rod for the whole travel is, therefore, 107·5 lbs. per sq. in. as against ·5 to 1 lb. per sq. in. with the spherical metallic packing of "Redford's Patent" type. The lubrication of piston and valve rods is a most important point, especially so where high pressures or highly superheated steam is used. Many points have to be considered, especially the one of carbonisation. The Spherical Co. carry this out in an efficient and thoroughly practical manner. It is purely metallic, automatic in action, and floats with the rod, keeping the latter surrounded with oil. This oil being isolated from the heat of the cylinder and from the steam, carbonisation is prevented.

Book Notices.—"A Record of the Baltimore Conflagration." By Edwin O. Sachs. London: The British Fire Prevention Committee, 1, Waterloo Place, S.W. 5s.

"Light Energy." By Margaret A. Cleaves. London and New York: Ribman Co. 21s. net.

Trade Announcements.—Messrs. Norton & Gregory, Ltd., specialists in photo-copying, drawing-office work and requisites therefore, have removed from Westminster Palace Gardens to Castle Lane, Buckingham Gate, where they have built new premises to cope with their increasing business.

The Rhodes Electrical Manufacturing Co., Ltd., have opened a branch office at Newcastle-on-Tyne, at 17, Eldon Square, under the management of Mr. Joseph P. Sleigh, late manager of the branch office of the British Thomson-Houston Co.

Imports of Foreign Electrical Machinery.—There was rather a heavy importation of foreign electrical machinery into this country during last month, the returns showing a total of £53,133, as against only £37,720 in October, 1903. The value of the imports during the ten months ending with October has attained a value of £477,061, which compares with £467,738 in the corresponding 10 months of last year.

Dissolutions and Liquidations.—A petition for winding up the Sir Hiram Maxim Electrical and Engineering Co., Ltd., presented by a creditor of Southport, is to come before the Courts in London on November 29th.

Mr. Alfred Hardie, the receiver and liquidator of the company, is submitting a scheme for reconstruction of the company to the creditors whose claims are over £10, and also to the debenture holders and shareholders. One of the conditions of the scheme is the payment in full of the creditors under £10.

The Transvaal.—The value of the electric wire, cables and fittings imported into the Transvaal during the eight months ending with August last is returned at £49,000.

Imports of Foreign Telegraph Cables.—The value of the foreign telegraph cables and apparatus connected therewith imported into this country during October is returned at £7,316, bringing up the total for the first 10 months of the year to £40,352, as compared with £50,199 in the corresponding period of 1903.

France.—The *Auto*, of Paris, announces its intention of organising a trial of electrical motor cars early next year.

Bankruptcy Proceedings.—A receiving order has been made on the petition of a creditor against Wm. Sumner, electrical engineer, of Dale Street, Liverpool.

The first meeting and public examination in *re* Henry Coles, electrical engineer, Swansea, are to take place on November 29th and December 16th respectively, the former at Carey Street, and the latter at the Town Hall, Swansea.

An adjudication order was made on November 14th *re* Albert Smith, of West Bridgford, lately trading as the Electric Motor Supply Co., now out of business.

A first dividend of 6s. 6d. in the £ is payable after November 29th (R. J. Ward, 2, Clement's Inn, Strand) in the case of Charles Aubrey Smith (trading as C. J. Smith, electrician, of King Street, Regent Street).

The first meeting of creditors under the failure of Walter C. Bersey, of Dacre House, Arundel Street, Strand, late of Queen Street, Cheapside, consulting engineer, in connection with motor-cars, was held before Mr. E. Leedam Hough, senior Official Receiver, at the London Bankruptcy Court, on the 22nd inst. The accounts filed showed gross liabilities £4,371 (£3,363 unsecured) and assets £21. There was no offer, and the case went into bankruptcy.

The public examination of Max Margowski (Automatic Telephone Co. (1903), Ltd.), is to take place on Monday, December 5th, at Carey Street.

At the Birmingham County Court last week, the public examination took place of James Marsden, electric fittings manufacturer. The examination was closed.

New G.E.C. Lines.—The General Electric Co., Ltd., in their October progress sheet put forward a number of new electrical specialities. Among their ampere and voltmeters is the "Stanley D'Arsonval" edgewise type, as shown in fig. 1. These instruments have been specially designed for general switchboard work. The movement is of the well known "Stanley D'Arsonval" moving-coil type, and is absolutely dead beat. The zero position is adjustable

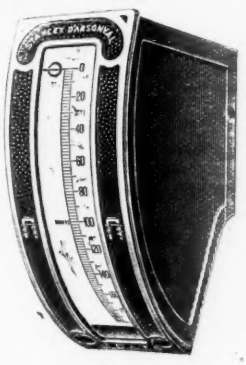


Fig. 1.

from outside the case, and the divisions of the scale are equal from zero to full load. The instrument is mounted in a strong iron case, enamelled black outside and white inside. The scale is of brass silvered and lacquered, is 8 in. in length, and is calibrated throughout its range by direct comparison with standards. The iron case protects the movement from the effects of external fields or masses of magnetic material. Either back or front terminals can be supplied. All ammeters are provided with a separately mounted shunt, the price of which is included in the price of the instrument. In fig. 2 we show the "La Force" sparking plug. This, an entirely new design, is of best quality, and the sparking points, which are of solid nickel, are easily cleaned, as they are both

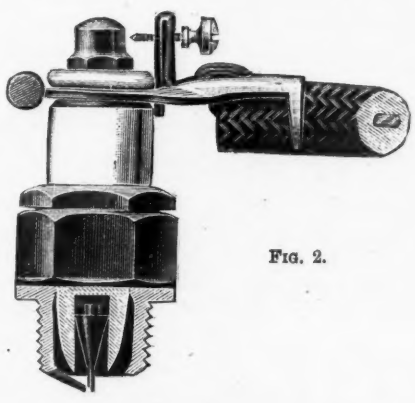


Fig. 2.

straight. The porcelain, at the combustion end, is so shaped as to form a recess between the outer body and the plug. The inner conductor also stands in a deep recess, so that there is a very large surface of the porcelain which must become corroded or deposited with carbon before the insulation of the plug is reduced sufficiently to allow partial conductivity. Consequently this plug will run considerably longer than any other without attention. This, in itself, is a great point, but is only one of the features that this plug possesses. The "La Force" plug is fitted with a patent clip at the terminal end of the porcelain, which allows of connection being made in a most thorough manner, making it impossible for it to shake loose, and at the same time holds the high tension wire by gripping the insulation instead of the copper conductor (as is usually the case), and relieves the conductor of all strain.

Electrical Trades Union.—A meeting of electrical workers of the city of Hull was held on Wednesday last week, the result being the formation of a branch of the above Union. The Glasgow branch of the above announces that its Annual Smoking Concert will be held at the Lorne Restaurant, Howard Street, Glasgow, on December 16th. The London branch is holding a Smoking Concert in aid of its benevolent fund on Saturday, December 10th, at the "Shamrock," Fetter Lane, where members and non-members are equally welcome.

Quick Tramway Work.—In our notice of the opening of the Royton and Crompton tramways in our issue of November 11th, we mentioned that "the contract had been carried out by Messrs. William Underwood & Bros., and that the work, comprising 6½ miles of track, had been constructed in the short period of 14 weeks." We are asked to point out that the whole of the overhead construction was carried out by the Brush Electrical Engineering Co., who completed the job within seven weeks.

Borough Polytechnic Institute.—On Wednesday last week, the new buildings which have been erected at the Borough Polytechnic Institute, in Borough Road, were formally opened by Mr. J. W. Benn, M.P., the Chairman of the L.C.C. The new buildings comprise an engineering laboratory, drawing offices, a lecture theatre and various rooms for gymnastic and other departments. Next year the marble bust of Michael Faraday, presented by Mr. Passmore Edwards, will be unveiled. The Polytechnic has issued a fully illustrated brochure describing the various departments, old and new, their equipment, and the work done by them.

Catalogues and Lists.—Messrs. A. Reyrolle & Co., Ltd., of Hebburn-on-Tyne, have issued some revised price lists of their tubular fuses, distributing panels and boxes, and house service fuse boxes, for inserting in the catalogue already in use.

Messrs. Norris Bros., of 14, Bridge Street, Middlesbrough, have published circulars relating to their improved raw-hide gears for machine tool, electric tramcar, motor and other work.

Mr. Leslie Miller, 93, Hatton Garden, E.C., has published a circular describing and illustrating a new milli-ampere meter for measuring the current through X ray vacuum tubes.

A circular just issued by the Pfluger Accumulator Works, of 39, Victoria Street, S.W., gives some good half-tone views of battery installations which have been carried out by them.

Messrs. W. E. Moulsdale & Co., of 24, Chapel Street, Liverpool, have sent us an illustrated circular, giving full details of their "Bifluid" tachometers.

Catalogue No. 153, which has come to hand from Erith's Engineering Co., of Gracechurch Street, E.C., deals with the "Cochrane" feed-water heater and purifier, and the patent automatic hot process purifier.

A descriptive circular and price list of Moore's patent differential pulley blocks have come to hand from Messrs. Head, Wrightson & Co., Ltd, of Teesdale Iron Works, Thornaby-on-Tees. These blocks are stated to reduce to a minimum the wear and tear peculiar to differential pulley blocks, and some of them have been in constant use for 12 to 15 years. They are made to lift up to 10 tons.

We have received from The Electrical Co., Ltd, a pamphlet entitled "Electrical Power Transmission in Mines," illustrating some of the most characteristic installations which they have carried out in this country and on the Continent. The three-phase high-tension sets and switchboard installed at the Binchester and Auckland Park Collieries; continuous-current generating sets for the Holwell Iron Co.; winding drum at the Frongoch mine in Wales, and many other plants at Dortmund, Cologne, Oberhausen, Zabrze, are illustrated. A separate pamphlet describes the electrically-driven winding engine at Preussen Pit No. 2 of the Harpener Mining Co., of Dortmund.

From the Electrical Co., Ltd., we have also received a pamphlet showing photographs of Nernst lamps installed by them in the Edinburgh Museum, Houses of Parliament, the Canadian Arch, and also in fashionable restaurants, drawing rooms, offices, railway stations, &c. In one very large establishment no fewer than 10,000 Nernst lamps are in use. The latter part of the pamphlet deals more particularly with these lamps used for street lighting purposes, and gives illustrations of lamps in use in Barnes, Maidstone and Gravesend. We learn that the Electrical Co., Ltd., have supplied Nernst lamps to considerably over 50 Corporations, and the works are very busy at present owing to the enormous demand for same, which is greatly increasing, more than 2½ million lamps being now in use. The last two pages deal with the latest types, namely, Express and Multiple lamps. Ornamental fittings, &c., are supplied by the company's Fittings Department, 162, Shaftesbury Avenue, W.C., and inspection of their showrooms is invited. Arrangements are being made for the works to bring out a new lamp, type "D" (similar to the small "B" type at present in use) in ½ ampere size for high voltage. This lamp will be specially suitable for street lighting purposes, and will be very low in price. Another new type of lamp is to be brought on the market, which will be suitable for 500-volt circuits, and will, no doubt, be appreciated by corporation engineers who have such pressure in their mains.

From the Rhodes Electrical Manufacturing Co., Ltd., we have received a new list of R E. type motors, giving particulars of the outputs at different speeds, also prices and approximate shipping measurements.

The Edison & Swan United Electric Light Co., Ltd., have issued a second edition of their Section II. catalogue of 1904 dealing with Ediswan ship, factory, colliery, street and traction fittings. We understand that there was such a large demand for the first edition, which we have already noted, that it has had to be reprinted. Advantage was taken of the opportunity to revise and enlarge the section, and some of the prices of ship and factory fittings originally listed have been altered. With regard to colliery fittings, the company are now listing a large size fitting with cast-

iron painted reflector and well glass, to take up to 5—32 c.p. lamps. A large assortment of all-porcelain fittings have been added, as well as cheap factory fittings and street lamp fittings. In addition, two pages of "Ediswan" traction fittings for the interior of tramcars have been added; these include several new and handsome designs. New illustrated leaflets of their h.v. switch plugs, and "Button" switch with "wedge" movement have also been issued to supplement their catalogue (Section 3).

Electrical Apparatus for Poland.—The French Consul-General at Warsaw, in his report for 1903, states that there is a good opening in Poland for all kinds of electrical apparatus, such as motors, batteries, dynamos, accumulators, electric lighting materials, ornamental fittings, incandescent lamps, arc lamps, electric toys and bells, telephone materials, &c. These goods are now imported mainly from Berlin and Vienna. The trade in electrical apparatus is not very large at present; but it is bound to extend, owing to the recent foundation of a central generating station. Despite the extension of the contract with a Dessau company for lighting the streets of Warsaw by gas, the use of electric light is becoming general in private houses and business establishments.—*Pall Mall Gazette.*

LIGHTING AND POWER NOTES.

Ascot.—A company is being promoted for the purpose of establishing a system of electric lighting for the Ascot, Sunninghill, and Sunningdale districts, and negotiations are now pending between the promoters and the Windsor R.D.C.

Birkdale.—The free-wiring scheme recently inaugurated by the Corporation in connection with its electricity supply, is stated to be giving very successful results.

Bromsgrove.—The Worcestershire C.C. has decided to have a complete electric lighting plant laid down at the Barnsley Hall Asylum in this district.

India.—Simla.—It was Mr. J. W. Meares, then electrical engineer to the Bengal Government, and now electrical adviser to the Indian Government, who once described Simla as "a place where every man had an electric lighting scheme in his pocket, and nothing was done." This reproach will be removed if the Indian Government sanctions the latest scheme, which is now introduced under the *aegis* of the municipality. As was the case at Mussoorie early this year, the lighting scheme now propounded goes hand in hand with one for new waterworks. At the end of last June the Government authorised the Simla Water Supply Committee to consider various schemes in connection with the necessity for an extension of the waterworks. The Committee's own scheme provides for using the water from the Nauti Khad, by cutting a channel along the hill side from Basantpur for a couple of miles to a small reservoir, whence with a head of 568 ft. the water will pass through steel pipes (some 1,800 ft. in length) to Mukercha, on the banks of the Sutlej. The water available in the driest of recent summers has been 23 cb. ft. per second. The present installation of 525 B.H.P. (in three sets of 175 B H P. each) will only require 12 cb. ft. per second, leaving a margin for subsequent extensions to 1,000 H.P. Three-phase current at 50 cycles is to be generated at 200 volts and transformed up to 10,000 volts for transmission along an aerial line, carried on creosoted deodar poles to Simla, which is 18½ miles distant. Two chief sub-stations are to be provided for dealing with the lighting load, one near Auckland House, the other near the Viceregal Lodge. Here the energy will be transformed down to 2,000 volts for further distribution at a potential of 225 volts from five smaller centres, at which transformer sheds will be erected. This method of housing the transformers, compare very favourably with the scheme proposed for Rangoon, of fixing these on the posts carrying the wires. Distribution in Simla will, of course, be overhead, the wires being carried on steel posts. For the public lighting, it is proposed to place along the main thoroughfares, lanterns 150 ft. apart containing two 25-c P. glow lamps. On other roads the lanterns are to contain two 16-c.p. lamps. In each case half the lamps would be extinguished after midnight. This will require nearly 200,000 units per annum, which at 2 annas per unit, will cost 25,000 rupees, or slightly more than double the present cost of oil lighting. It is proposed to supply energy to large consumers such as the Viceregal Lodge (which needs about 32,000 units per annum) at 5 annas per unit. Smaller consumers would be charged 6 annas.

The chief load will, of course, come from the supply of energy for pumping purposes. At the pump houses at Cherot and at Chair, step-down transformers will supply low-tension three-phase current, to two 60-B.H.P., and one 80-B H P. pumps. The reserve pumping plant will consist of one of the existing steam sets, one 60-H P. and one 80-H.P. pumps. In 18 hours, without calling on reserve sets, 320,000 gallons will be pumped to a head of 1,300 ft at Cherot, and 100,000 gallons to a head of 2,750 ft. at Chair. Hitherto the cost of fuel for pumping has been rather heavy; in 1903 23,000 maunds of wood (the maund is 82·28 lbs.), and 17,000 maunds of Barakar coal were required for the boilers at Cherot at a cost of 26,250 rupees.

In concluding, it may be mentioned that the Committee proposes to install a steam-driven 120-kw. set for emergency use at their generating station. Like all the Himalayan hill districts, Simla is liable to landslips, and the fear is entertained that such a slip may carry away the flume which supplies the power house.

The N.W. Railway is introducing electric punkahs and lights in its railway coaches, which will, no doubt, considerably conduce to the comfort of passengers in the hot season.

Chester-le-Street.—The Rural Council has been again approached by the County of Durham Electrical Power Distribution Co., for consent to the company applying for an electric lighting prov. order for the area.

Colombo.—Messrs. Boustead Bros., who are the contractors for supplying the Government and the various buildings and firms in Colombo, with electric power for lighting and other purposes, have entered into a new contract with the Government. The new terms are more favourable to Government, and the contract was signed on October 1st, and is to be for a period of 10 years, as from January, 1904. In making this agreement, Messrs. Boustead Bros. have sacrificed 18 months of the former contract.

Croydon.—The T.C. is seeking powers to supply energy in bulk to local authorities outside the borough, to deal in motors, dynamos and various fittings, and to meet, out of the rates the expenses of holding exhibitions to demonstrate the advantages and encourage the sale of electricity.

Culford Hall.—Messrs. Davey, Paxman & Co. have recently put down for the Earl Cadogan, K.G., at Culford Hall, Bury St. Edmunds, a complete electric light installation. The plant consists of a horizontal compound engine, belt-driving a multipolar dynamo, and also two single-cylinder horizontal engines. Steam is supplied from three Davey-Paxman locomotive boilers, working at 140 lbs. pressure per sq. in. Other accessories include donkey pumps, injectors, &c.

Denny.—The T.C. has decided to apply for a prov. order for electric lighting. A company, it is stated, contemplates supplying the district with electricity, and the Council desires to "safeguard" its interests.

Dublin.—The Corporation has passed a resolution, that the Lighting Committee furnish to the next meeting of the Council a report setting out the financial condition of the undertaking up to the present, and that the Committee undertake no further or additional constructional works until the consulting engineer reports that the works covered by his agreement in 1899 have been completed. The Committee was also instructed to furnish full particulars of the capital expenditure and the amount necessary to complete Mr. Hammond's original scheme, to the next monthly meeting of the Corporation.

Bideford.—The T.C. has resolved to apply for a prov. order for E.L.

Falkirk.—The T.C. proposes to erect a number of Luna Nernst lamps in a portion of the burgh as an experiment, and the Lighting and Electric Light Committee has received the necessary powers.

Finchley.—A L.G.B. inquiry was held recently into the application by the U.D.C. for sanction to borrow £17,000 for E.L. purposes. The electrical engineer stated that applications had been received during the last six months, at the rate of approximately 300 (equiv. 8-c.p.) lamps per week. It is even thought the sum asked for would not be sufficient to carry the department through the winter. There was slight opposition on the part of the North Middlesex Gas Co.

Glasgow.—In connection with the new goods station which the N.B.R. are at present constructing in High and Duke Streets, all the machinery for handling the goods is to be worked electrically, and will include a number of overhead travelling cranes, including one capable of lifting 30 tons, and electric capstans and traversers.

Grangemouth.—The T.C., on the recommendation of its E.L. Committee, has resolved to postpone making application for a prov. order, and in the meantime to procure further information and the probable terms to be granted by the Scottish Central Electric Power Co.

Heston and Isleworth.—The inaugural ceremony in connection with the U.D.C. electric light undertaking took place on the 14th inst. The plant equipment consists of three Babcock and Wilcox boilers, two being in connection with the refuse destructor; two tandem compound three-crank Davey-Paxman engines of 200 H.P. each, fitted with superheaters and direct coupled to two 150-kw. generators, supplied by Messrs. Frank Suter & Co.; a third engine of the same type but of 400 B.P. being on order. A Hughes and Sterling destructor is being erected, steam from this source being not yet available. The contractors for the condensers were Messrs. Körting Bros; switchboard, the B.T.H. Co.; accumulators, the Tudor Co.; economisers, Messrs. Green & Son; feed pumps, Messrs. Hayward & Tyler; water softener, Messrs. Lassen & Hjort. The supply is on the three-wire system, at 480 volts between the outers. The consulting engineer to the scheme is Mr. J. S. Enright, and the Council's electrical engineer is Mr. F. A. Bond.

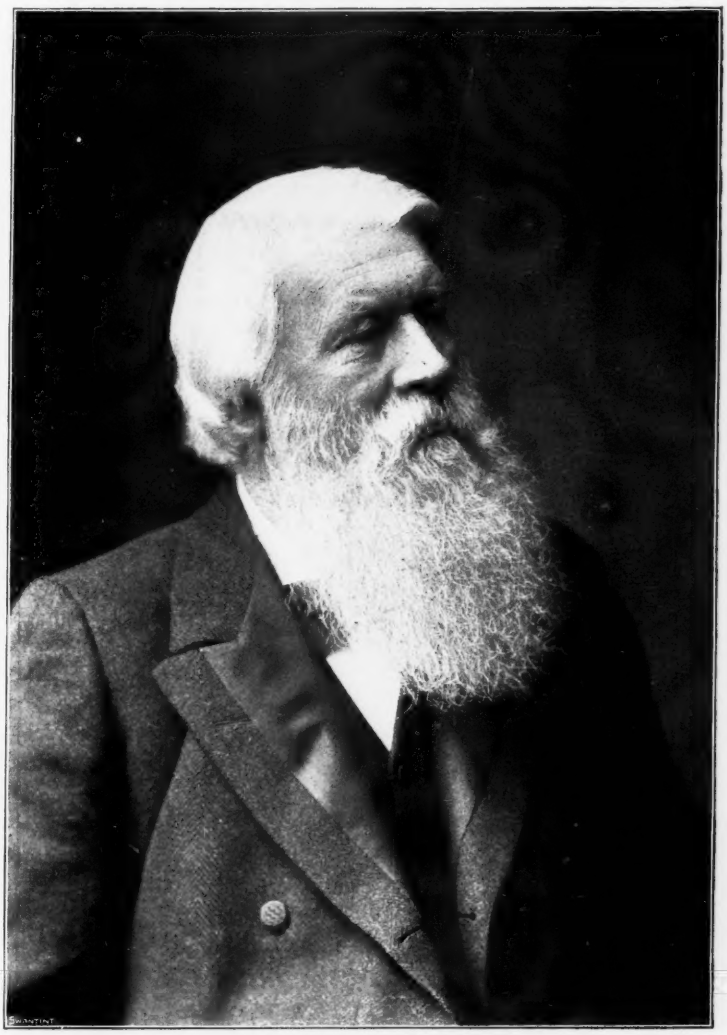
Retford.—At a ratepayers' meeting, held on the 21st inst., a resolution was carried, urging the T.C. to abandon its proposed scheme for the electric lighting of the district.

(*Continued on page* 871.)

SIR JOSEPH WILSON SWAN, F.R.S., D.Sc. &c.

Sir Joseph Swan, whose name appeared in the recent list of recipients of "Birthday" honours, is one of the grand old men of the electrical profession, and by the nature of the case is one of the first few to attain that dignified position. Born at Sunderland, on October 31st, 1828, his early years were employed in the service of chemistry. In partnership with his future brother-in-law, Mr. John Mawson, he founded the well-known Newcastle firm which bears their joint names, and his quickness in following up the photographic discoveries of Fox-Talbot and Daguerre gave a marked bent to the business, which became widely famous for the manufacture of collodion, and at a later date—after the publication by Dr. Maddox in 1871 of the method of substituting sensitised gelatine for collodion — of dry plates as well. The discovery that heat is an essential in the preparation of *rapid* plates was made by him, and in those early days there were no plates that could compare with those produced by Mawson and Swan for sensitiveness and rapid action.

Copyright.] [Swan Elec. Eng. Co.



Sir Joseph Wilson Swan, F.R.S.

The "carbon process," which under the name of "Auto-type" has brought the world's art treasures into every household, was patented by Swan in 1864, and may be said not only to have worked a revolution in photography, but to have laid the ground as well for some of the most important processes of mechanical reproduction, including photogravure. The carbon print, as most people are aware, consists of a sensitised gelatine film impregated with a permanent pigment or dye, and the selective action of light acting upon it through a negative, and rendering the gelatine more or less insoluble, results in a relief print which is practically permanent, and in which the tones are dependent upon the greater or less thickness of the material.

He is also the prime inventor in what is known as Woodburytype, which is, in fact, a mechanical way of producing a carbon print, and constitutes a valuable addition to previously known methods of mechanical printing.

Mr. Swan's work in this field covers nearly every branch of photography and photographic reproduction, including that of half-tone engraving (or etching), the most widely used of all mechanical processes. Bromide printing paper, for rapid printing by artificial light, was proposed and patented by him in 1879.

Coincidently with his photographic work, Mr. Swan, from a very early date, was interested in electricity, and with that unswerving devotion to a main idea which characterises his career, and is the secret of most successful invention, he worked for one object, namely, the production of a resistance lamp. Staite's platino-iridium incandescent wire, shown in 1845, was the clue which he followed, and by 1860 he had practically mastered the first step, that of producing slender filaments of carbon possessing strength and elasticity and enough conductivity to serve the purpose required. Mr. Swan had actually made a lamp with a carbon filament at that date, and had shown it to several of his friends, a spiral carbon being mounted in a hermetically sealed glass shade, which was exhausted of air as well as was then possible, by means of a chemical air pump, whilst the current for lighting it was supplied by 50 cells of Callan's modification of Grove's battery. The invention of Sprengel's air pump in 1865, and the development of the dynamo between 1870 and 1880, gave the final stimulus to this branch of research, in which Edison, Lane-Fox and others were also engaged; and the relative share which each is entitled to claim in the final production is now a matter of ancient history, and is written at length in the annals of patent litigation. But whatever may be the value of patents as a test of merit, it is an undoubted fact that the actual form of incandescent lamp now in universal use, and the method of preparing filaments from a jet of cellulose material forced through a die, are due to Swan, together with many subsidiary details. Mr. Swan's earliest lamp was shown at a lecture given by him at Newcastle in February, 1879; and in October, 1880, the first public exhibition of incandescent lighting was given by him at the Newcastle Lit. and Phil. Society, when the rooms were illuminated solely by these means.

It is probably not generally known that Sir Joseph Swan was the original inventor of the cellular plate for secondary batteries, the use of which has become a marked feature of modern improvements in accumulator manufacture. He has also to be credited with numerous inventions in the field of electro-chemistry, prominent among which is a rapid process of depositing copper, which, with suitable apparatus, enables pure copper wire to be reeled off from the bath through a die. Under laboratory conditions, with this process, which involves a rapid movement of the cathode and a continuous stream of the electrolyte, smooth deposition of pure copper has been accomplished at a current density of 100 to 1,500 amperes per sq. ft. So far, however, it has not come into com-

mercial use, owing to the care which is required in many details.

Some 60 patents have been granted to the subject of this notice, for inventions in almost every branch of science—from "medicinal rhubarb" to "fire-damp indicators for coal mines," and from "desilverising lead" to "chrome tanning of leather."

The honour recently conferred upon Sir Joseph Swan has come tardily enough, in the opinion of his compeers, considering the vast amount of useful work which lies to his credit. But in scientific circles he has not been without a fair meed of recognition. In 1894 he was elected a Fellow of the Royal Society. The University of Durham has conferred upon him honorary degrees of M.A. and D.Sc., and on the close of the Paris Exhibition of 1881, he received the decoration of Chevalier of the Legion of Honour. He was President of the Institution of Electrical Engineers in 1898-9, and of the Society of Chemical Industry in 1900 and 1901. At the present moment he is President of the Faraday Society, and even since the publication of the recent Birthday List, he has been awarded for his "invention of the incandescent electric lamp and various improvements in the practical applications of electricity" the Hughes medal of the Royal Society.

THE HON. C. A. PARSONS, F.R.S., C.B.

The Hon. C. A. Parsons, upon whom His Majesty, in the recently published Birthday List, conferred special honour by appointing him to be a Commander of the Bath, will ever figure prominently in the scientific and engineering history of the closing years of the nineteenth century, by virtue of the far-reaching effect of the invention and applications of his steam turbine. And in these opening years of the twentieth century there is abundant evidence that the great work which, with immense diligence and undaunted perseverance, he has succeeded in setting on foot, will continue to increase in importance for many years yet to come.

By birth Mr. Parsons comes of a distinguished family, being the fourth son of the third Earl of Rosse, who died in 1867, and was succeeded by his eldest son, the present Earl. The inventor of the Parsons turbine was born in 1854, so that he is now just over 50 years of age, and all of his admirers will hope that he may be spared for many years to witness further remarkable developments in the turbine field, perhaps including the evolution of Parsons turbines driven by gas.

From the biographical records it appears that Mr. Parsons was eleventh wrangler at Cambridge in 1876. The exact date at which he entered the electrical industry we do not know, but he was for some years a partner in the famous firm of Clarke Chapman, Parsons & Co., at Gateshead, before starting the separate business of C. A. Parsons & Co., in 1890, in Gateshead, and afterwards at Heaton, Newcastle-on-Tyne. The well-known firm of C. A. Parsons & Co., of which he is proprietor, has had a very high reputation for its electrical machinery and construction work for many years; but it is undoubtedly his turbine work which has brought him into such great prominence among engineers of recent years. In 1884, as he told the Institution of Electrical Engineers last year, the first compound steam turbo-dynamo (of 10 H.P.) was constructed. It ran at 18,000 r.p.m., had an armature of 3 in. diameter, ran successfully for some years, and now rests in South Kensington Museum. Before this, however, preliminary experiments had taken place at Gateshead-on-Tyne.

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The Hon. Charles A. Parsons, F.R.S., C.B.

This is briefly the story of the day of small things. What has happened since needs no further telling, except to state that the Parsons steam turbine has been constructed for electrical work in all sizes up to 7,000 kw. Even five years ago,* when we described the works of C. A. Parsons & Co. and their equipment for the manufacture of turbines and electrical generators, the demand was increasing at so rapid a rate that plans were then preparing for quadrupling the size of the works, and later extending them to six times their then dimensions.

The Royal Society elected Mr. Parsons (who was already a D.Sc.) a Fellow in 1898, and the official notice recorded that it was "for his invention of the compound steam turbine, which he has adapted successfully to dynamo driving and other uses, and for his recent application of it to marine propulsion."

Mr. Parsons is managing director of the Parsons Marine Steam Turbine Co., Ltd., and is a director of the Newcastle and District Electric Lighting Co., Ltd., the Cambridge Electric Supply Co., Ltd., the Scarborough Electric Supply Co., Ltd., and the Parsons Foreign Patents Co., Ltd.

He has favoured the Institution of Electrical Engineers, the British Association for the Advancement of Science, and other engineering and scientific Institutions with valuable papers showing the various stages and phases of his practical development of the Parsons machines, and was President of the Engineering Section of the British Association at the Cambridge meeting of 1904.

* Electrical Review, November 10th, 1899.

ALEXANDER SIEMENS—THE NEW PRESIDENT OF THE I.E.E.

Since the foundation of the Institution of Electrical Engineers as the Society of Telegraph Engineers and Electricians 33 years ago, the distinguished honour of being invited to occupy the presidency of that body for a second term has only fallen to a few. The late Dr. C. W. Siemens, F.R.S., and the late Dr. John Hopkinson, F.R.S., together with Lord Kelvin, Sir W. H. Preece, F.R.S., Mr. Robert Kaye Gray, who has just retired from office after 20 months of admirable and generous service, and now Mr. Alexander Siemens—one of the Institution's original members, who was president in 1894—complete the list. The reasons for Mr. Gray's extension of presidential duty, and for the re-occupation of the chair of office in 1905 by Mr. Siemens, are already quite familiar to readers of the Electrical Review.

Copyright.] [Reinhold Thiele & Co.

Mr. Alex. Siemens, M.I.C.E., M.I.M.E., President of the I.E.E.

Mr. Alexander Siemens, M.I.C.E., M.I.M.E., was born in the early days of 1847 at Hanover. His connection with electrical manufacturing dates from his 20th year, for it was in 1867 that he first entered the works of Siemens Bros., which had just been erected at Woolwich. In the following year he was engaged in the erection of telegraph lines in Persia, for the Indo-European system, and upon certain cable-laying operations between Djuba and Sotcha. He later returned to Germany to continue his studies, and served with credit in the Franco-German war. In the following Autumn, 1871, he came to London and worked as a pupil in the office of Dr. C. W. Siemens, where, during the next few years, he designed and erected regenerative furnaces.

In September, 1875, Mr. Siemens joined the cable-ship *Faraday* (owned by Messrs. Siemens Bros.) so as to gain further experience in submarine telegraphic work, and he was stationed at Halifax, N.S., during 1876 and part of 1877. The first continuous working glass furnace erected in England was started by him in 1878, and as was related by Mr. Siemens in his recent Presidential address, was received with opposition by the trade union.

In 1879 he undertook the management of the electric lighting department of his firm and installed the electric arc light in the Albert Hall and the British Museum reading room. In this year his firm undertook the first street lighting by electricity and also began supplying private houses, and it was at Godalming that the first central station was started for illuminating the street by this means. Messrs. Siemens Bros. also, at about this date, carried out the electric tramway between Portrush and the Giant's Causeway.

Sir William Siemens died in 1883, and Mr. Alexander's active connection with the firm became more responsible from this time forward, and in 1887 he was made one of its directors. In 1891 he undertook the sole management.

We have already shown in our issues of Aug. 19 & 26, 1904, what a great development has taken place in the manufacturing business of the firm, resulting in the establishment of their new factories at Stafford for the manufacture of electrical machinery and apparatus for lighting, power and traction.

Mr. Siemens was a member of the Committee to inquire into the system of light railways. In 1893 he went as one of the official delegates of the British Government to the International Electrical Congress held at Chicago, and held the same position at the Paris Congress of 1901. He sat on the Royal Commission held in 1897 to inquire into the desirability of establishing a National Physical Laboratory, and he is now on the Executive Committee of that important Institution. He is also a member of the Admiralty Committee which since 1902 has been considering the possibilities of utilising electrical energy more extensively on His Majesty's ships.

He is a vice-president of the emergency Committee of the Federation of Engineering Employers, has served on the Council of the Institution of Civil Engineers since 1898, is a member of the Iron and Steel Institute, the Institution of Mechanical Engineers, an honorary member of the Society of Engineers, and so on.

Mr. Siemens is a strong and earnest advocate of the metric system, and members of the London body of the I.E.E. will well remember the debate between himself and the late Sir Frederick Bramwell last year. His presidential address delivered a few weeks ago contained one more educative attempt in this connection. We hope that Mr. Siemens's present term of presidency of the Institution of Electrical Engineers will be successful in the highest degree.

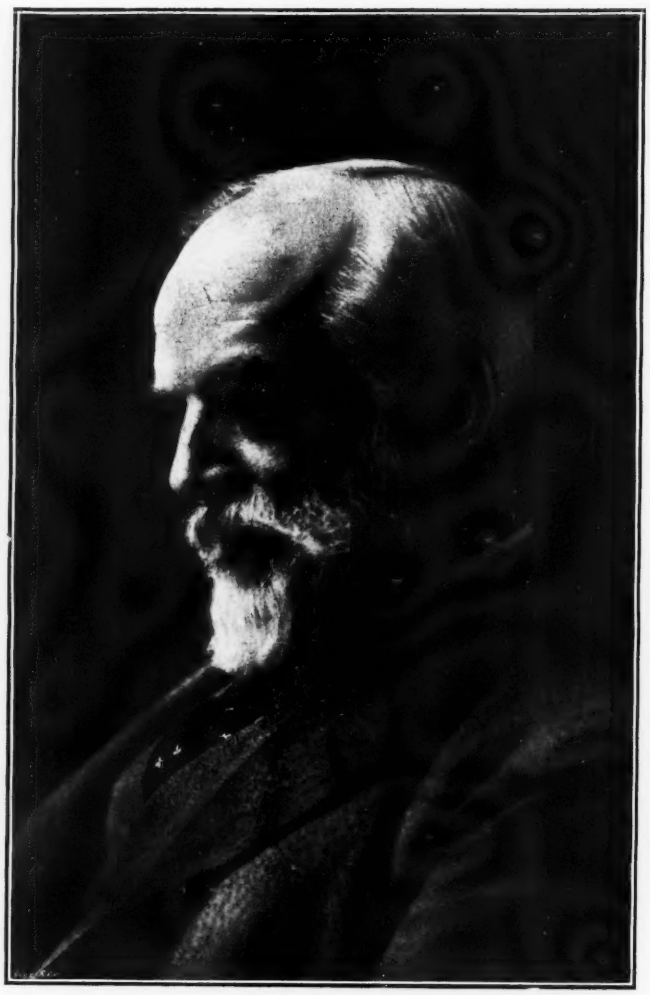
ROBERT KAYE GRAY—PAST PRESIDENT I.E.E.

There are a few men amongst us to-day who stand out from among their fellows as of quite rare temperaments. To come into even casual touch with them impresses one at once with their exceptionally fine nature—they cannot be other

than courteous and kindly in the merest details about which they may be approached ; in short, they are rare and lovable natures.

We believe that in Mr. Robert Kaye Gray we have one of the finest examples of this class. Not many men in the electrical world have so readily won universal esteem and regard from their compeers. None who have had intercourse with him, either in his connection with the very old-established Silvertown Co., or as the distinguished President of the Institution of Electrical Engineers, will fail to agree with us when we say that he is an English gentleman of the best type—modest, generous and courtly, ever ready to render any service that lies within his power for the benefit of his profession—and for many who are without it, too—yet always most persistent in his efforts to shun advertisement or publicity.

His efforts in this last-mentioned direction may have enabled him to escape the intrusive searchings of biographers, but they have not inclined him to leave unfilled any of the numerous and important engagements which fell to his account during his occupancy of the presidential chair. His term of office, extended by the exigencies resulting from the death of a valued official of the Institution, has been one of hard work, has involved multitudinous engagements and arrangements, which have made great demands upon his diplomacy, time and means, and now that he has retired from that position of eminence and falls back to some extent from the more open gaze of the electrical public, all will join with us in testifying that he has played his part with thoroughness, with exceeding grace and with unstinting generosity.



Mr. Robert Kaye Gray, Past-president of the I.E.E.

Mr. Gray was born north of the border in June, 1851, so that as men count years he is still comparatively young. After commencing his education at Greenock he came to London in 1865, and entered the University College School, afterwards going to University College, and later—in 1869—he went to Paris to still further continue his studies under a private tutor.

In 1870 he went to the West Indies as electrician on the staff of Sir Charles Bright. The following year, after recovery from an attack of yellow fever, he went, during the Franco-German war, to lay the cable from Gravelines to Bordeaux. His father, the late Mr. Mathew Gray, was in charge of this expedition. In 1872 he acted as electrician-in-chief, with Mr. F. C. Webb as engineer, in laying the Direct Spanish Cable from the Lizard to Bilbao, and also the cable from Marseilles to Algiers for the French Government. Two years later, in 1874, he was sent out as engineer-in-chief of the whole staff of the ships *Dacia* and *International* to the West Coast of America, to lay the cable between Valparaiso and Callao (Lima). The second Marseilles-Algiers cable was laid by him in 1879, and the third in the following year. These operations brought him into close touch with Sir Samuel Canning, Mr. Herbert Taylor, Mr. H. R. Kempe, and many other early workers in submarine telegraphy. Other expeditions for which he was responsible were the laying of the Mexican and Central and South American and other cables in 1882 and 1883, and the Canaries and Senegal Cables in 1883 and 1884.

Mr. Gray represented various companies at the International Telegraph Conferences in Paris, Buda-Pesth, and last year in London. Mr. Swinburne's term of office of President of the I.E.E. was voluntarily curtailed, and Mr. Gray came to the chair a few months earlier than was the custom in order that one so intimately connected with our great telegraph interests should be at the helm when the important gatherings of the International Telegraph Conference took place in London.

Three years ago, after the death of his father, Mr. Robert Kaye Gray was appointed managing director of the India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd., of Silvertown, of which he was already on the board.

In February, 1903, he was appointed President of the Institution of Electrical Engineers. During his presidential year many events of great moment called for serious attention, among them the visit of the Institution to Italy. The death of the late secretary brought many anxieties and duties to Mr. Gray toward the close of his year in the chair, and Prof. Silvanus P. Thompson, in June last, told members of the Institution that it was "largely owing to Mr. Gray's unremitting attention that the continuity of the work of management went on without break or interruption." It is undoubtedly true that the Council and the entire Institution owe great indebtedness to him for the "wonderful way" in which he devoted his time and energy to tiding over "a terrible gap." By accepting presidential office for an extended term, Mr. Gray did the Institution an honour, and he, throughout the extension period, had again many important calls upon his time and kindly offices. The McMillan Memorial Fund, which has now reached the respectable figure of £1,760, the Dr. Gilbert ceremonial at Colchester, the visit to St. Louis Exhibition and other American electrical gatherings at which Mr. Gray had ample opportunities for winning the esteem of our trans-Atlantic *confrères*, have all happened in the additional eight months during which he has acted as president.

Mr. Gray possesses several Orders from the Spanish and Portuguese Governments, and is a member of the Council of the Society of Arts; a member of the Institution of Civil Engineers, the Physical Society and the London Institution. He is a director of the Cuba Submarine Telegraph Co.; the West African Telegraph Co.; the South American Telegraph Co.; and the Spanish National Submarine Telegraph Co.

He is a life governor of many hospitals and other charitable institutions, and has always favoured associations concerning themselves with the welfare of sailors and electricians with his benevolence.

The esteem in which the subject of this article is held by the large staff of officials connected either directly, or through associated companies, with the India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd., at Silvertown, at Cannon Street, and at the other establishments, is exemplified by the casual remark made to us the other day by a gentleman at the offices to whom we were expressing our indebtedness for certain courtesies:—"We don't mind what trouble we take—we are all so fond of Mr. Gray!"

LIGHTING AND POWER NOTES.

(*Continued from page* 866.)

Bexley.—The U.D.C. has agreed to supply Mr. R. C. Baines, the owner of the Foot's Cray prov. order, with energy for lighting and power purposes, the price being 3d. per unit up to 20,000 units per annum and 2½d. per unit beyond, with a minimum of £250 per annum. Mr. Baines lays all the cables, and is to receive 1d. per unit from the U.D.C. for any energy it supplies through his cable to Lamborbey. The agreement may be terminated by two years' notice from the U.D.C. on terms to be settled by the B. of. T.

Bury.—The R.D.C. is about to apply for a prov. order to empower it to supply electricity throughout its area.

Hull.—A L.G.B. inquiry was held on 16th inst. into the application of the City Council for sanction to borrow £4,600 for electric lighting purposes.

The arbitrator appointed to consider the assessment of the municipal electric light undertaking has reduced the figure from £7,081 to £2,714.

Cardiff.—Mr. A. Ellis, the borough electrical engineer, waited upon the Finance Committee recently to explain the need for borrowing £87,868 for extensions. He stated that he had decided not to put any more plant in for the present winter. Both the Canton and Roath stations were running full load, there being no spare plant. It would be necessary to put in more plant for next winter. Notice had been given to contractors in the town that further consumers could not be connected for the present winter. The proposed new loan would cover the whole of the applications to the L.G.B. for the next two or three years. The contracts in hand, in the Penarth Road district alone, for power are equivalent to over 4,000 lamps, and there are contracts for a similar number in Dumballs Road.

Kildare.—The electric lighting of the town was inaugurated on the 3rd inst. The work has been carried out by the National Electric Construction Co. to plans and specifications drawn up by their engineer, Mr. W. H. Clegg. A loan of £3,350 was obtained by the Naas No. 1 D.C. to carry out the undertaking, and the contractors are to run the station for five years from the date of opening. A producer gas plant, by Messrs. Salmon, Whitfield & Co., of Kettering, has been put down, and consists of two generators of a capacity of 60 H.P. each. Two Newton-L.D.M. gas sets of 16 KW. each, and also a booster by the latter firm, have been installed. The switchboard is by the National Electric Construction Co., and consists of six panels—two dynamo, two feeder and two battery and booster regulator panels. The battery consists of 110 cells of 300-amp.-hour capacity. About three miles of B.I. & H. armoured concentric mains have been laid, supply being on the two-wire system at 200 volts. The public lighting consists of 12 1-ampere Nernst and 18 double-16-C.P. lamps, and it is intended to substitute electric motors for oil engines for pumping the town water supply. The prices to be charged are 7d. per unit for lighting and 3d. for power. For this brief description we are indebted to the *Irish Engineering Review*.

London.—The Metropolitan Electric Supply Co., Ltd., intends applying for a Bill enabling it to supply and distribute energy for all purposes in Westminster, St. Marylebone, St. Pancras, Holborn, Hampstead, Paddington, Kensington, Hammersmith, Chelsea and Fulham, in the county of London, and in Ealing, Acton, Hanwell, Southall—Norwood, Greenford, Uxbridge, Hayes, Chiswick, Brentford, Heston and Isleworth, Twickenham, Teddington, Hampton, Hampton Wick, Sunbury, Feltham and Staines; conferring upon the company powers for breaking up the streets in the areas mentioned, and enabling them to lay down mains, &c., for the purpose of supplying energy "in bulk" for distribution to users by authorities or companies. The Bill will contain clauses empowering the company and the Acton U.D.C. to make agreements with respect to the supply of energy to the Council; authorising agreements as to the supply of energy with local authorities, companies, &c.; and extending the company's powers under their order of 1890 to the whole of the metropolitan borough of Paddington. Another clause will provide for the distribution of any moneys received by it in connection with the sale of its Marylebone undertaking, and will empower the directors either to return the money to the shareholders or to provide for its employment. The notice adds that the Bill may provide that the Electric Lighting Acts of 1882 and 1888 shall not apply to any undertaking to be authorised by the intended Act, and that the measure may incorporate the Electric Lighting Clauses Act of 1899 with modifications. The company also intends to apply for leave to bring in a separate Bill empowering it to supply energy to the Acton U.D.C.

CHARING CROSS AND STRAND ELECTRIC SUPPLY CORPORATION, LTD.—This company intends to apply for a Bill to supply and distribute electrical energy in bulk or for power purposes to that part of the City of Westminster known as the parish of St. Martin-in-the-Fields, and the district formerly known as the Strand district, and that part of the metropolitan borough of Holborn which comprises so much of the district formerly known as the Holborn district and of the district formerly known as the St. Giles district, as lies to the south of an imaginary line drawn along the centre of New Oxford Street and High Holborn; the City of London and the liberties thereof.

The metropolitan boroughs of Islington, Stoke Newington, Hackney, Finsbury, Shoreditch, Bethnal Green, Stepney, and Poplar, in the County of London; the county borough of West Ham, the urban districts of East Ham, Barking Town, Ilford, Romford, Wanstead, Leyton, Walthamstow, Woodford, Buckhurst Hill, Chingford; and the parish of Dagenham, in the rural district of Romford, in the county of Essex; and the urban districts of Edmonton, Tottenham, Hornsey, Wood Green, and Southgate, in the County of Middlesex.

To confer upon the company powers to lay down mains in the area of supply.

To define the purposes for which and the circumstances in which the company may supply energy in the area of supply, and to define the terms upon which and the circumstances in which the company may be required to afford a supply.

To enable the company to take and recover rates and charges for or in respect of the supply of energy under the intended Act.

To authorise the company and any authorised supply authority to enter into agreements for the supply of energy to the latter, also to enable the company to supply energy to any railway company or for the purposes of working any railways or tramways; to any canal or dock company, to any Government department, and to any public authority or body, and to make special provisions with respect to the utilisation of such supply by the persons to whom the same is given, whether within or without the area of supply.

BERMONDSEY.—The accounts of the B.C. E.L. undertaking which have been recently issued show a revenue for last year of £7,991, and an expenditure of £5,834, leaving a balance of £2,157. After paying interest and sinking fund charges there remains a net balance of £513.

MARYLEBONE.—The Finance Committee reported on Tuesday that the total of the sums advanced from time to time out of the general fund on electricity account amounted to £165,292, of which £151,743 had been repaid up to October 24th last, leaving a balance of £13,549 to be repaid to the general fund, to which has to be added the interest chargeable, which amounts to £3,164, making together a sum of £16,714 due to the general fund as at October 24th, 1904. The Electric Supply Committee reported that the borough accountant had submitted the final results of the examination of the Metropolitan Electric Supply Co.'s accounts for capital expenditure, May to August inclusive. The net result of the audit of the accounts was a balance due to the company of £2,918. The Electric Supply Committee further reported having agreed to accept the conditions attached to the consent of the L.C.C. to the proposed change of pressure, to a uniform continuous current supply at 240 volts.

WANDSWORTH.—A reply has been received from the B. of T. to a letter recently sent by the B.C., relative to the accounts of the County of London Electric Supply Co., Ltd. The Board states that is is not prepared to say that the requirements of the Electric Lighting Act, 1882, have not been complied with by the company, or that it can call on the company for more detailed statements of accounts. The Lighting Committee has considered a letter from the County of London Electric Supply Co., Ltd., in which it offers to supply energy for public street lighting at a flat rate of 2d. per unit; or, if a larger scheme is adopted, a further reduction might be considered. The report states that the initial cost of each electric lamp with column fixed, complete, and connected with the company's main, would be £19, and, at 2d. per unit, the annual cost of lighting (including maintenance of lamps, &c.), £18 10s. The Committee decided that the cost of the proposed scheme would be too great, but, if the cost of energy were reduced, it would be prepared to reconsider the matter.

STEPNEY.—Opposition is to be offered by the B.C. to any Bill promoted by the L.C.C. for the purpose of relieving the last-named body of the obligation for obtaining the consent of the several

road authorities concerned, to the use of an overhead system of traction.

Hackney.—The Finance Committee has placed with the Municipal Mutual Insurance, Ltd., the insurance of the boilers at the electric lighting and dust destructor works. Application is to made to the L.C.C. for a loan of £6,500, for electric lighting purposes, chiefly extensions of mains.

The County of London Electric Supply Co., Ltd., are applying for a Bill in the ensuing session of Parliament, to enable them, among other things, to supply energy in bulk to any authority or person authorised to supply or use electricity, within the U.D. of Tottenham, the City of London, and the metropolitan boroughs of Hackney, Shoreditch, Southwark, Lambeth and Battersea, or in any area adjoining any of the areas of supply of the company, and to enable the necessary mains and works for this to be carried out.

Marlborough.—The local E.L. company has asked the T.C. to consent to its application for a prov. order for electric ighting. The Corporation has asked the company for particulars as to price, &c.

Newtown (N.S.W.).—Last month the Council had before it a proposal from local business men stating that they were prepared to install an electric light and power plant in the town on a convenient site, together with an up-to-date refuse destructor; to light the borough with electricity, install 100 arc lamps, each 1,500 c.p., and 400 street incandescent lamps, each 40 c.p.—a total of 154,450 c.p., as against the present illumination of 11,550. They further proposed to destroy the refuse and light the borough for the total annual charge of £2,400. As the project would involve a capital outlay of £24,000, they asked the Council to give them the exclusive right to erect poles and to run wires in the borough for private lighting and power, they would charge no more to consumers than the City Council of Sydney, without the consent of the Borough Council; also that the Council enter into a contract with them for a period of ten years, with the right of purchase of the plant, &c., as a going concern on terms. Ultimately the matter was referred to the Finance and Lighting Committees to consider and report upon.

New Zealand.—New Plymouth.—The E.L. Committee has accepted the tender of the Brush Electrical Engineering Co. for £5,453, for installing the electric light into the town.

Christchurch.—The Kaiapoi Woollen Manufacturing Co. has decided to install electric power for working the whole of its factories.

Hawera.—The inauguration of the Hawera Electric Light Co.'s installation took place in September last. Mr. Barton, the promoter of the scheme, obtained reports in 1901 as to the estimated cost of a supply for the county, and in 1902 the company was formed to carry out the project. A Bill was passed by Parliament, giving the company right to convey electrical energy through an area of 225 sq. miles in Taranaki. The Bill includes Hawera, Manaia, Kaponga, Eltham (this borough being excepted unless it gives consent), and Normanby. The water-power is obtained more easily and cheaply than usually owing to the peculiar course of the Waingongoro River, a site on which cost the company £3,000; the river reaches the Normanby-Okaiawa Road, and, after making a detour of 1 mile, doubles back to within 2 chains of its former course. A fall of 40 ft. has been obtained by driving a tunnel through the intervening bank and under the road, and at the lower end the power house has been erected, a dam not being necessary. Two horizontal turbines, each of 230 h.p., with a speed of 600 r.p.m., have been installed, and are direct-coupled to three-phase alternators of 65 kw. at 5,500 volts. The exciter sets are mounted on the shafts of the alternators. The switchboard consists of four marble panels, two for the generating sets, and two to control the two main transmission lines to Hawera and Manaia. The five transmission lines are carried overhead, on poles set at about 40 to the mile. The voltage of transmission, 5,500, is stated to be the highest pressure yet utilised in New Zealand. At each town the energy is transformed down to a suitable pressure for commercial purposes. The company has the contracts for the street lighting of Hawera, Manaia and Normanby, and it is anticipated that a demand for power will arise for driving machinery in the various industries within the company's area. The works may be increased to 700 h.p. by providing a dam at the power house, if it is so desired. The whole of the work has been designed and carried out by Messrs. Steuart & Fenn, of Dunedin. The manager of the undertaking is Mr. J. Trevithick. The prices for energy at Hawera have been fixed for private lighting at 10s. per 8-c.p. lamp per annum up to 12 lamps, and 7s. 6d. per 8-c.p. after, up to 24, and 5s. per 8-c.p. beyond; power, 8s. 6d. to £14 per h.p. per year, and with special terms to long-hour users.

Wellington.—The C.C. intends to take over the public lighting of the city in August next, and has notified the Wellington E.L. & P. Co.

Cambridge.—The question of lighting the town by electricity is being considered by the Council.

Dunedin.—On September 28th, the City Council received an offer from the Waipori Falls Power Co., stating that they would be prepared to recommend the shareholders to accept £35,000, in 4½ per cent. Corporation debentures, for the whole of the rights and assets of the company, the Corporation to take over all the commitments and contracts of the company also, at from September 1st. At a special meeting subsequently held, the Council resolved by seven votes to three to close with the offer, the purchase being in one-third cash, and the balance in debentures.

Waipori Falls.—In the House of Representatives at the end of September, the report of the Private Bills Committee on this electrical power Bill was discussed. The Bill is to empower a private company to utilise the Waipori Falls for the purpose of generating electricity to be supplied to a large surrounding district, and the question at issue was as to whether the company should be accorded power which will enable it to come into conflict with the Dunedin City Council, which has in hand a scheme for the supply of electricity on its own account from the Lee stream. Among the amendments made in the Bill by the Committee, was the addition of a proviso prohibiting the company from supplying energy for lighting or domestic heating within Dunedin without the consent of the Corporation, but this prohibition is not to apply in cases where the company is supplying a certain amount of energy for industrial purposes. The municipality of Dunedin was given the power to purchase the company's undertaking within a certain time, and on certain conditions. Ultimately the Bill was, by 33 votes to 22, referred back to the Committee, with instructions to excise the city of Dunedin from its provisions.

Oldham.—At the last meeting of the Electricity Committee, the new chairman stated that the Committee had borrowing powers to the extent of £244,510, whilst the expenditure up to November was £262,424. Beyond that the completion of the contract would require another £14,050, so that the total amount overexpended was £31,964, which was included in the sum of £48,000, which the Committee is seeking power to borrow.

Ormskirk.—The B. of G. has resolved to purchase from Messrs. Guinness, of Dublin, two engines, two dynamos, certain instruments, and a switchboard, and to install it at the workhouse for supplying lighting and power. The plant has been in use in Messrs. Guinness's brewery for about seven years.

Perth.—The Committee has recommended, and the T.C. agreed to take in offers for the erection of the additional plant advised by Mr. Lambert, in view of the electrification of the tramways, and also to apply to the Secretary for Scotland for authority to borrow to the extent of £6,000 to meet the cost.

Plymouth.—Vehicular traffic in a certain street in Plymouth is suffering from the excitements of electric shocks due to a leakage over a small area of the roadway. The Corporation electrical department are investigating the matter.

Pontypridd.—The U.D.C. has decided to borrow £23,000 for E.L. purposes.

Portsmouth.—The military authorities have decided to have Eastney Barracks lit by electricity, and energy for 3,000 lamps will be taken from the Corporation.

Stratford-upon-Avon.—The Corporation is applying to the B. of T. for alterations and amendments under its 1901 prov. order, respecting extension of time and transfer powers. (See *London Gazette*, November 18th.)

Topsham.—The price of current has been fixed at 5d. per unit for lighting, and 3½d. per unit for power. Supply is to be commenced in a week or two.

Tottington.—The Lancs. Electrical Power Co. are applying in the ensuing session of Parliament for a prov. order to supply electricity for public and private purposes and for tramways within the above U.D.C.'s area.

West Riding.—The B. of T. has revoked the West Riding E.L. order, 1902.

Worsley.—The B. of T. has informed the U.D.C. that the question of revoking the E.L. order will be deferred for a year.

York.—The E.L. Committee has accepted a tender for the installation of electric coal haulage plant at the Foss Island works at a cost of £735.

TRAMWAY AND RAILWAY NOTES.

Aberdare.—The U.D.C. has resolved to construct six lines of tramways at a cost, including the provision of power stations, cars and motors, car-shed, and a refuse destructor, of £93,574 14s. 10d.

Belfast.—The Tramways Committee on 21st inst., agreed to consult the engineer with a view to having British-made rails used. Mr. Young, who has been engaged as expert valuer of the track, wrote giving some valuable hints. It was decided to ask Mr. John Fell to act as additional expert valuer, and Mr. G. F. Milner to give evidence as to the rolling stock.

Black Country.—Last week an official of the B. of T. visited the Black Country for the purpose of inspecting the new electric tramway recently constructed by the Rowley Regis U.D.C. between Old Hill and Blackheath, the cost of which has been £32,000. Everything was found satisfactory, and sanction was given to open the line. As a result, the cars commenced running for traffic on Saturday afternoon last, a mutually advantageous arrangement having been arrived at between the B.E.T. Co. and the Rowley Regis Council.

Bradford.—The Corporation is applying for tramway powers for Hipperholme, and notice is filed in the *London Gazette* for November 18th.

Bury.—It was agreed at the instance of the Tottington local authority to insert a clause in the Parliamentary Bill, to be promoted next session, giving Bury power to construct lines to Ramsbottom by way of Greenmount and Halcombe Brook as an alternative to the Brandlesome Road route.

Chicago.—Mr. Geo. W. Jackson, municipal engineer, has presented estimates to the amount of £3,830,312 for a 10-mile underground electrical car service. Chicago has already an underground electrically-operated freight line.

Dover.—The Corporation has decided to take over the powers of the River Light Railways Syndicate, and to extend its electric tramway system to the suburb of River at a cost of £21,000.

Dundee.—The Tramway Committee has declined to reduce the working hours of the employés from 60 to 54 hours per week. The Committee was guided in its decision by a report dealing with the subject of working hours in other centres.

Exeter.—The city surveyor reports to the Tramways Committee that the contractors have completed rather more than one-half of the permanent way.

Hull.—As a result of the arbitration proceedings, the increased assessment of the municipal tramways has been reduced from £23,284 to £16,626.

Liverpool.—The Corporation is applying for further tramway powers, which are particularised in a notice filed in the *London Gazette* for November 18th.

London.—Hammersmith.—The B.C. on Wednesday last week appointed a representative to a committee of delegates of local authorities, formed to consider what steps should be taken to abate the alleged nuisance caused by the noise of the trams of the London United Tramways, Ltd.

Luton.—The T.C. has resolved to apply to the B. of T. for a prov. order authorising the construction of seven lines of electric tramways in the town.

Morecambe.—Negotiations were proceeding between the Tramways Co. and the local authorities respecting the electrification of the trams, and before long shareholders will be called together to consider a proposal.

New York Central Railroad.—The N.Y.C.R.R. is erecting two enormous power houses to supply current for the pending electrification of its suburban service. They will be of identical architectural design. Each structure will be 235 ft. long, 167 ft. wide and 125 ft. high, with two chimney stacks of 290 ft. each, and an internal minimum diameter of 17 ft. The coal bins will have a capacity of 6,000 American tons. The main switchboards will be in an adjacent building, but can be controlled if needed from the engine room. The plant at each station will normally develop 30,000 kw. There will be 16 steam turbines directly connected with the dynamos, and each turbo-generator being supplied by its own boilers, will constitute an independent unit. The electric locomotives for use on the railway are being built by the General Electric Co., at Schenectady, N.Y. They were officially tested on November 11th, and are designed to haul a heavy passenger train at the rate of 70 miles an hour.

Rhondda.—The U.D.C. is seeking powers next session for tramway extension and other works, of which notice appears in the *London Gazette* for November 18th.

Southend and Colchester.—Notice appears in the *London Gazette* of November 18th respecting the scheme of the Southend and Colchester Light Railways Co., for which powers are to be sought in the coming session.

Snowdon Light Railway.—Sir Herbert Jekyll heard objections last week to the confirmation of the order passed by the Light Railway Commissioners for a light railway from Snowdon to Betts-y-Coed, a distance of 13 miles. The proposed railway (a 2-ft. narrow gauge, worked electrically) was opposed by the National Trust for Places of Historic Interest or Natural Beauty, the Co-operative Holiday Association, the Alpine Club, representatives of colleges at Oxford and Cambridge, and memorialists from all parts of the kingdom. The promoters said they had done everything to avoid interfering with the natural beauties of the neighbourhood, and the whole of the landowners affected were in favour of the scheme. Sir Herbert Jekyll said the Board of Trade would consider the objections, and give a decision shortly.

Wolverhampton.—Our Wolverhampton correspondent writes:—As the result of Tuesday's snow-storm, a horse has, it is believed, been killed by a "live" stud. The animal had been hired by the Corporation to drag the scraper along the tramline in order to clear away the snow. This horse and another were dragging the scraper towards the town, when the leading horse suddenly fell. The animal was raised to its feet, but the second one also dropped to the ground, breaking the shafts of the machine. The horse is stated to have "shivered" and "quivered" for a second or two, and on assistance being rendered by some men who witnessed the occurrence, it was found to be dead. Another horse trod upon a live stud in Piper's Row, and fell, injuring its side. Several other horses mysteriously collapsed while passing along the track, and were seen to tremble. It is, therefore, not an unnatural supposition that there was some stray electric current. Mr. Shawfield, the borough electrical engineer, however, emphatically declares that the dead horse was not electrically killed. These incidents caused some excitement in the locality at the time. A rather remarkable occurrence was that in which a dog was concerned. The creature emitted an agonising howl, leapt into the air, and fell, afterwards showing a clean pair of heels. Officials from the electrical department were soon on the spot testing the studs, and safeguarding matters as far as possible.

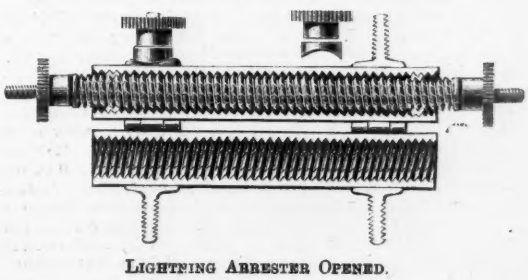
Underground Railway for Manchester.—It is reported in the financial papers that a new scheme is on foot for the construction of a tunnel railway 2½ miles long for Manchester, the estimated cost being put down as £750,000.

TELEGRAPH AND TELEPHONE NOTES.

The Cable to Dakar.—The *Times* Paris correspondent stated on November 21st that a vessel conveying the third section of the cable between France and Dakar had just left Calais. "In certain Colonial circles the expenditure of nearly 25,000,000 fr. (£1,000,000) on this cable is considered useless. In defending the project in Parliament it was urged that, in case of war, Senegal would run the risk of having its communications with the mother country cut off. But in consequence of the recent explorations across the Sahara and the development of French influence in those regions, it is certain that for an annual expenditure of 200,000 fr. or 300,000 fr. (£8,000 or £12,000) it would be possible to establish and maintain communication by wireless telegraphy between Algeria and Senegal as well as the other regions dependent on those two colonies. These communications would offer the further great advantage of not being exposed to interruption in case of war."

Cables for Cuba.—The ss. *Dacia* left Millwall Docks on Saturday last, 19th inst., with 470 nauts of cable, manufactured for the Cuba Submarine Telegraph Co., Ltd., by Hooper's Telegraph and India-Rubber Works, Ltd., to be laid by this company on the South Coast of Cuba, between the ports of Cienfuegos and Santiago, and for repair work. This will be the third cable which the Hooper Co. have manufactured and laid for the Cuba Submarine Telegraph Co. between the same points. The first was laid in 1875, and worked for 28 years, until last year. The other cable, the core of which was manufactured in 1872 or 1873 for the Western and Brazilian Co.'s cable, was laid in 1881, and worked for some 16 years, when it was found unrepairable on account of the sheathing having decayed. The Hooper Co. have also manufactured and laid for the Cuba Submarine Telegraph Co. the two cables between Cienfuegos and Batabano, and a cable between Santiago and Cape Cruz and Manzanillo.

Lightning Arrester for Telegraph and Telephone Instruments.—A new pattern of lightning arrester for land line telegraph and telephone instruments has been devised by Mr. L. E. Caine, M.I.E.E., Superintendent of the East Africa and Uganda Telegraphs. This arrester consists of an inner soft iron rod, and an outer tube of any suitable metal, preferably copper or brass. The inner rod is cut to the depth of about $\frac{1}{8}$ in. in longitudinal parallel lines about $\frac{1}{8}$ in. apart. A screw thread of about 16 threads per inch is then cut from end to end along the rod, the depth of the cut being $\frac{1}{8}$ in. This screw thread is for the purpose of winding insulated wire around the rod from end to end. The longitudinal cuts are for the purpose of producing numerous points on the edges of the threads. The rod has a brass milled-head screw and washer at each end. The outer tube is hinged to open and close. It has two brass screws of similar pattern to those on the rod. These screws will serve as rests for the arrester to stand on, as well as for the earth wire connection. The inside surface of the tube is cut similarly to the outside surface of the rod. Two



Lightning Arrester Opened.

circular insulating washers fit round the inner rod to prevent contact between rod and tube. These washers should be so cut that the space between the rod and tube varies from about $\frac{1}{16}$ to $\frac{1}{32}$ of an inch. The object of the design is to impede the lightning current and coax it to spark inside the tube. The potential of a lightning discharge being so high, it is supposed that all metallic paths are practically equally available, and thus some of the current would pass through the wire round

the rod, exhausting some of its energy in magnetising the rod and also increasing the self-induction of the helix. German silver insulated wire would perhaps be best for winding round the rod, on account of its resistance and high melting point. Three or four wires might be so wound. The great self-inductance interposed in the path of the lightning, and the multitude of points at which it can go to earth, should make the arrester highly effective in protecting instruments.

Municipal Telephones.—A provincial paper says that from a report just issued, it appears that the increase in the number of the National Telephone Co.'s stations at Glasgow during the year ended October 31st was 4,923, and at Swansea 661, the rates of increase, notwithstanding municipal competition, being 37 per cent. and 36 per cent. respectively.

Telegraphic Interruptions and Repairs :—

Cables.	Interrupted.	Repaired.
Trinidad-Demerara (No. 1)	Aug. 26, 1901	..
Trinidad-Demerara (No. 2)	Oct. 10, 1904	Nov. 20
Dominica-Martinique	May 7, 1902	..
St. Lucia-Martinique	May 7, 1902	..
Cayenne-Pinheiro	Aug. 13, 1902	..
Reissa-Issa (Yemen)-Camaran	Oct. 22, 1902	..
Tarifa-Tangier	Jan. 18, 1904	..
Closed { Vladivostock-Nagasaki	Feb. 9, 1904	..
Closed { Port Arthur-Chefu	Mar. 9, 1904	..
Paramaribo-Cayenne	July 13, 1904	..
Swakopmund-Mossamedes (under repair)	Oct. 10, 1904	..
Nassau-Jupiter Inlet	Oct. 20, 1904	..
Rhodes-Sitia	Nov. 1, 1904	Nov. 22
Mozambique-Majunga	Nov. 15, 1904	..
Santa Cruz de Teneriffe-Tejita	Nov. 11, 1904	..
Marseilles-Barcelona	Nov. 11, 1904	Nov. 30
Sitka-Valdez	Nov. 11, 1904	..
Caimanera-Santiago	June 15, 1904	..
Landlines.		
Cartagena-Baranquilla	Dec. 8, 1900	..
Puerto-Barrios	July 28, 1902	..
via Bhamo beyond Tingyuch	Oct. 15, 1904	..
Kertch-Soutehoum	Sept. 27, 1904	..
Saigong-Bangkok	Nov. 15, 1904	Nov. 17
Rome-Constantinople	Nov. 15, 1904	Nov. 18
Rome-Constantinople	Nov. 19, 1904	Nov. 20

Wireless Telegraphy.—Before the German Society of Naval Architects, in Berlin, last week, Prof. Braun read a paper on "The Methods and Aims of Wireless Telegraphy." In the course of the discussion which followed, the desirability of all the various systems of wireless telegraphy being united or amalgamated as a matter of international convenience was referred to.

The *Daily News* of November 19th states that the Admiralty have fixed upon Hagnish Tree, in the island of Tiree, as a wireless telegraph station. It will be in communication with Malin Head in the North of Ireland and Duncansbay Head north-east of Caithness. The Admiralty intend erecting a mast 160 ft. high. Suitable houses are to be built for coastguardsmen, who will have charge of the station.

Wireless Telegraphy in Bengal.—A report on wireless telegraph experiments in the Bay of Bengal during March, April and May, was recently furnished by Mr. M. G. Simpson, electrician to the Indian Telegraph Department, who conducted them personally. The report was recently abstracted in the *Pioneer*. The Lodge-Muirhead system was used, and the necessary apparatus, including oil engines and dynamos, was sent from England to Rangoon, Elephant Point and Amherst having been selected as the places between which an attempt was first to be made to establish communication. A single wooden mast 150 ft. high had been erected at each point, the distance between the two being 85 miles across the Gulf of Martaban, with no land intervening. A dynamo and engine were landed at Elephant Point on March 1st, and by noon on the 4th the station was complete, the sparks required for signalling being freely obtained. The station at Amherst was then similarly formed, and on March 16th the first trial was made. Occasional signals were received, but nothing readable could be obtained. Mr. Simpson was joined at this time by Captain Halliday, R.E., who was fresh from England, where he had been doing some very successful overland experiments with the Lodge-Muirhead system. A communication was also received from Dr. Muirhead himself advocating the use of four masts instead of one in order to form what is known as a "carpet aerial." Mr. Simpson was confident that he could get communication with a single mast, but in view of work over his next circuit from Amherst to Diamond Island (212 miles) he decided to erect a "carpet aerial" 100 ft. high and 100 ft. square at Amherst. While this was being done experiments were continued with the single mast, and after trying various changes with the instruments and some new transformers that opportunely arrived from England, perfected signals were received from Elephant Point on March 27th. Thereafter everything sent from that station was read at Amherst. But then came trouble from atmospheric disturbances due to electrical discharges in the upper regions of the atmosphere. However, good signals were received at Elephant Point from Amherst on April 7th, and thus communication was established both ways.

The second experiment was over the 212 miles from Amherst to Diamond Island, the "carpet aerial" at the former station having been completed on April 9th. The apparatus at Elephant Point was moved to Diamond Island, where a second "carpet" was made. Spars were cut from the cotton trees on the island, and everything was ready by May 11th. A single 150-ft. mast had previously been erected, and trials were made in the intervening period, but no readable messages could be got through. The signallers were never sure whether they were getting "atmospherics or messages from Amherst, and the conclusion arrived at was, that even under the most favourable conditions it would be doubtful whether a single aerial 150 ft. high would suffice for signalling over the 212 miles with 70 miles of low-lying deltaland intervening. From May 12th to the 17th, and all through the night of the 17th—18th the "carpet aerial" was tried, but the atmospheric disturbances were felt as much as with the single mast. There seemed no chance of success so long as the "atmospherics" continued, and as the monsoon was setting in, and it was not practicable to live in tents on the island, the experiments had to be abandoned for the season. Mr. Simpson's conclusions are, that the disturbances which interfered so much with his work prevail only for about two months before and two months after the south-west monsoon. His experiments showed that communication over 85 miles of sea could certainly be established with only one mast, and that probably a longer range could also be obtained. Nothing was learned about the "carpet aerial," but as this form is the one strongly advocated by Sir Oliver Lodge, it should be tried in any further experiments. He therefore recommends that such trials be made this cold weather from Diamond Island to Table Island and Port Blair, four masts, 150 ft. high, being used if necessary. We understand that this will be done, as communication with the Andamans is the end really sought. Everything is being got ready for these further experiments.

CONTRACTS OPEN AND CLOSED.

OPEN.

Ashton-under-Lyne.—November 29th. The Tramways Committee of the Corporation invites tenders for constructing about 1,180 yds. single track tramway. Plans, specifications, quantities and any information from Borough Surveyor, Town Hall.

Australia.—December 28th. A notice appears in the *Board of Trade Journal* to the effect that tenders will be received at the office of the Deputy Postmaster-General, Perth, W. Australia, for the supply of the undermentioned telephone material, for use in that State:—19½ miles 26-pair lead-covered cable, dry-core, to standard specification No. 7; 5,000 paper sleeves, 3 in. long by $\frac{3}{16}$ in. diameter; 350 yds. paper strips, 2 in. wide. General conditions, special conditions, specifications, schedule of items and tender forms may be obtained at the General Post Offices at Perth, Adelaide, Melbourne, Sydney, Brisbane and Hobart.

Austria.—November 29th. The Municipal Authorities of Vienna are inviting tenders until the 29th inst. for the supply of three electric cranes for the Tramways Department.

Bolton.—November 30th. The Electricity Committee has a vertical engine and two alternators for sale. See "Official Notices" November 11th.

Bromsgrove. — Engines, dynamos, booster, steam services, storage battery, switchboard, ring main, feeders, wiring, lamps, &c., for the new lunatic asylum. See "Official Notices" November 18th.

Dublin. — December 5th. The D.U.T. Co. wants tenders for a year's stores. See "Official Notices" November 18th.

Edinburgh.—December 14th. Electric lighting installation for the Branch Free Library. See "Official Notices" to-day.

Egypt.—Electric lighting materials required for Municipality of Suez. See Egyptian *Journal Officiel*, November 5th, at Commercial Intelligence Branch, B. of T.

France.—December 1st. The Municipal Authorities of Paris are inviting tenders for the supply and erection of a 60-H.P. steam engine and 40-KW. continuous-current dynamo in the Municipal School of Physics and Industrial Chemistry for lighting and power purposes. Particulars may be obtained from, and tenders are to be sent to, l'Hotel de Ville, Paris.

Hackney.—Tenders are about to be invited for an automatic coal-weighing machine.

Halifax.—December 1st. Electric light installation for the New Theatre Royal. See "Official Notices" to-day.

Johannesburg.—December 27th. Transformer pillars and switchgear; also two 35-ton electric overhead travelling cranes, for the Municipal Council's electrical undertaking. See two "Official Notices" October 28th.

Kilmarnock.—December 6th. Advertising on tramcars. See "Official Notices" to-day.

Leith.—November 26th. 30 electric double-deck cars; seven ditto with top covers, sprinkler car, &c., for the Corporation; also tram rails, fish-plates, fish-bolts and tie-bars. See two "Official Notices" November 18th.

Llandilo.—December 6th. Testing and calibrating the electricity meters installed in the town (70) for the U.D.C.

London.—December 10th. Tender for 12-ton, 40-ft. span electric travelling crane, with drawings and specification to B. E. Nightingale, Albert Works, Albert Embankment, S.E.

Oldham.—November 25th. Two negative return feeder boosters with switchgear and boards, for the tramway system. See "Official Notices" November 11th.

Roumania.—January 28th, 1905. Tenders are being invited by the municipal authorities of Guirgin for the concession for the electric lighting of the town.

Salford.—December 3rd. One feeder booster. See "Official Notices" November 18th.

Shanghai.—March 31st, 1905. Construction and working of 24 miles of electric tramways on the trolley system, double or single. See "Official Notices" October 14th.

Spain.—December 12th. The Municipal Authorities of Salamanca are inviting tenders until December 12th for the concession for the electric lighting of the town during a period of 10 years. Particulars may be obtained from El Secretario del Ayuntamiento de Salamanca, to whom tenders are to be sent.

Swansea.—December 1st. Motors and starting switches—12 months' supply. See "Official Notices" November 18th.

Wakefield.—November 26th. The Corporation is prepared to receive tenders for stores required in the Electric Lighting Department for the year ending December 31st, 1905. Particulars and tenders from City Electrical Engineer.

CLOSED.

Brussels.—The Corporation has accepted the tender of Messrs. W. F. Jones & Co., of Cannon Street, E.C., for 2,500 cable-connectors with special pilot wire terminals.

Fulham.—The British Westinghouse Co. has received the contract for the main generator switchboard.

Hackney.—The Electric Supply Committee has provisionally placed the following orders:—Demand indicators, the Reason Manufacturing Co., Ltd., 250, thermal type, at schedule prices; Schattner Electricity Meter Co., Ltd., 250, magnetic type, at schedule prices; air compressor, Messrs. Reavell & Co. (British Thomson-Houston motor), £83 9s. 6d.; arc lamps and pillars, Messrs. Johnson & Phillips, £999 5s.

London.—The London County Council Fire Brigade Committee has received the following tenders for the wiring and fittings for the new station at Kensington:—

Donnison Sillem & Co.	(accepted)	..	..	..	£176	10	0
W. H. Johnson	..	..	..	..	..	183	15	0
F. J. Coleby & Co.	..	..	..	..	..	189	10	0
A. H. Marshall & Co.	..	..	..	..	..	189	10	0
Durell & Co.	..	..	..	..	..	189	13	0
Oliver Clark & Co.	..	..	..	..	..	205	0	0
National Electric Construction Co.	..	..	..	213	0	0
Leo Sunderland & Co.	..	..	..	..	..	215	0	0

The tenders of the undernoted firms have been accepted by the London County Council for the supply of electric fittings, cables, &c., during the ensuing year:—

British Insulated & Helsby Cables, Ltd.,
Estler Bros.,
Falk Stadelmann & Co., Ltd.,
General Electric Co., Ltd.,
Highton & Co.,
St. Helens Cable Co., Ltd.,
Siemens Bros. & Co., Ltd.,
and the Craig Park Electric Cable Co., Ltd.

Marylebone.—The Electric Supply Committee has placed a provisional order with the Reason Manufacturing Co. for the purchase and fixing of 5,784 maximum demand indicators for £13,847. It is intended in the first place to hire the indicators, which are to be bought at the end of the year if the Council then decide upon adopting the maximum demand system.

St. Pancras.—The Borough Council has accepted the tender, at £103 10s., of the British Westinghouse Electric & Manufacturing Co., Ltd., for supplying and fixing electric motors to drive the machinery at the baths.

The Institution of Civil Engineers.—At last Tuesday's meeting a paper on "Distribution of Electrical Energy" was read by Mr. John Francis Cleverton Snell, M.Inst.C.E.

FORTHCOMING EVENTS.

Friday, November 25th.—At 7.30 p.m. Institution of Electrical Engineers (Manchester Students). "Electric Power in Machine Shops," by Mr. H. C. Jenkins.
At 7.30 p.m. North-East Coast Institution of Engineers and Shipbuilders. Mr. W. R. Cummins on "A Comparison of Vertical and Horizontal Tubes in Water-tube Boilers."
At 5 p.m. Physical Society. Meeting at the Royal College of Science. Dr. W. E. Sumpner on "The Measurement of Small Differences of Phase." Exhibition of Apparatus.

Saturday, November 26th.—At 7.30 p.m. Glasgow Technical College Scientific Society. "The Electrical Drive of Large Reversing Engines working Intermittently," by Mr. M. Georgi.
At 10 a.m. Institution of Electrical Engineers (Students). Visit to Great Northern, Piccadilly and Brompton Railway tunnelling.

Monday, November 28th.—At 8 p.m. Society of Arts. Mr. Arthur Lee on "The British Canal Problem."

Tuesday, November 29th.—At 7.30 p.m. Institution of Electrical Engineers (Manchester). "Compensated Alternating Current Generators," by Mr. Miles Walker.
At 8 p.m. Institution of Civil Engineers. Discussion on Mr. J. F. C. Snell's paper on "Distribution of Electrical Energy."

Wednesday, November 30th.—At 7.30 p.m. Institution of Electrical Engineers (Students). Mr. L. S. Pumphry on "Motor Controlling Switchgear."

Thursday, December 1st.—At 7 for 7.30 p.m. Institution of Electrical Engineers. Annual dinner at the Hotel Cecil.
At 8 p.m. Rugby Engineering Society. Mr. F. W. Carter on "Some Notes on High Speed Electric Railway Work."

Friday, December 2nd.—At 8 p.m. Junior Institution of Engineers. Mr. H. E. Yarrow on "Some Points of Interest in the Construction of Torpedo Boats."

Saturday, December 3rd.—Institution of Electrical Engineers (Manchester Students). Visit to the Corporation sub-stations.

The following papers, &c., are down to be read during the 1904-5 session:—

INSTITUTION OF ELECTRICAL ENGINEERS (MANCHESTER).

December 13th.—Mr. L. Andrews, "High-Tension Switchgear."
January 17th.—Mr. H. W. Wilson, "Electric Driving in Textile Factories."
January 31st.—Messrs. L. B. Atkinson and C. J. Beaver, "Some Points on the Selection of Electric Cables."
February 14th.—Messrs. S. L. Pearce and H. C. Gunton, "Manchester Tramways Power Supply."
February 28th.—Mr. W. J. A. London, "Mechanical Construction of Steam Turbines."
March 3rd.—Annual Dinner.
March 14th.—Prof. Schwartz and Mr. W. H. N. James, "Low Tension Thermal Cutouts."
March 28th.—Mr. A. B. Mountain, "Use of Electrical Energy in Mines and Collieries."
April 11th.—General meeting.

SOCIETY OF ARTS.

February 13th, 20th, 27th and March 6th.—Mr. Dugald Clerk, "Internal Combustion Engines."
March 13th, 20th, 27th and April 3rd.—Mr. H. Laws Webb, "Telephony."

INSTITUTION OF ELECTRICAL ENGINEERS (MANCHESTER STUDENTS).

December 16th.—Mr. E. D. S. Shelmerdine, "Battery and Booster Working."
January 13th.—Mr. A. E. Jepson, "Electric Heating."
February 3rd.—Mr. V. H. Mahler, "The Electric Equipment of Automobiles."
February 24th.—Mr. Buttenshaw, "Metallography."
March 17th.—Mr. C. R. St. John, "High Tension Switchgear."
April 7th.—Mr. M. Jennison, "Electric Cranes."

GLASGOW TECHNICAL COLLEGE SCIENTIFIC SOCIETY.

December 10th.—Mr. J. D. Mackenzie, "Electro-metallurgy."
February 4th.—Prof. Blyth, "Kathode Rays and Allied Phenomena."
March 4th.—Mr. G. Ness, "Steam Generators and their Failure."
March 18th.—Mr. C. Day, "Independent Condensing Plant."

ASSOCIATION OF ENGINEERS-IN-CHARGE.

December 4th.—Mr. G. H. Herbert, "Oil Engines."
January 11th.—Mr. H. Allen, "Gas Producer Plant and Gas Engines."
February 8th.—Mr. J. Tullis, "Belt Driving."
March 8th.—Mr. J. J. Lassen, "Water Softening."
April 12th.—Messrs. J. H. Coste and E. T. Shelbourn, "Lubricating Oils."

TRAMWAYS AND LIGHT RAILWAYS ASSOCIATION.

In December.—Mr. Stephen Sellon, "Running Powers."

THE ELECTRICAL VOLUNTEERS.

CAPTAIN WILFRID C. DUMBLE, R.E., for the O.C.E.E.R.E. (V.) asks us to publish the following orders:—

Monday, November 28th.—"A" Company—Recruits' Drill 6 p.m.; Technical Instruction, 7 p.m.
Tuesday, November 29th.—"B" Company—Recruits' Drill, 6 p.m.; Technical Instruction, 7 p.m.; Medical Inspection for Recruits and Special Service Section, 7 p.m.
Wednesday, November 30th.—No Adjutant's Drill till further orders; Submarine Mining Class, 6—9 p.m.
Thursday, December 1st.—"C" Company—Recruits' Drill, 6 p.m.; Technical Instruction, 7 p.m.
Friday, December 2nd.—"D" Company—Recruits' Drill, 6 p.m.; Technical Instruction, 7 p.m.
Saturday, December 3rd.—Manœuvres with R.A.M.C. (V.) at Hampstead Heath.

The Institution of Electrical Engineers.—At the ordinary general meeting of the Institution, held at Westminster last night, a paper on "Hydro-dynamical and Electro-magnetic Investigations regarding the Magnetic Flux Distribution in Toothed-Core Armatures," by Prof. H. S. Hele-Shaw, F.R.S., Alfred Hay, D.Sc., and P. H. Powell, M.Sc., M.Eng., was read.

NOTES.

McMillan Memorial Fund.—It is announced that the committee appointed to receive contributions towards the above has now decided to close the fund on December 1st next. The sum collected amounts to about £1,760, and any members who intend still to contribute would greatly oblige by sending in their remittances to the secretary of the Institution, Mr. Lloyd, before the end of November.

The Electrical Engineers R.E.V. Regimental Dinner.—This popular corps held their second annual regimental dinner at the Criterion Restaurant on Saturday, 19th inst., Colonel R. E. B. Crompton, C.B., officer commanding, in the chair. A large gathering of officers, non-com. officers, and men availed themselves of the opportunity of social intercourse. After the usual loyal toasts, Colonel Crompton proposed "The Guests." Colonel Maxwell, in reply, referred to his practical association with the corps in South Africa, and testified to their usefulness in setting up and working searchlights for the protection of the railways, lighting the hospitals and camps, and generally assisting the Royal Engineers in the repair of railways and bridges. Prof. Ewing, also replying, referred to the war and warfare of engineers and the increasing necessity of expert knowledge. Colonel Crompton, in replying for "The Corps," proposed by Colonel Pitt, R.E., referred to the fact that General Chaffee, of the U.S.A. army, had questioned him on the regulations of the corps, especially with regard to the fact of officers passing through the ranks before being recommended for commissions. "The Permanent Staff" and "The Press" toasts were duly honoured and responded to. An excellent programme of music was provided, Mr. T. E. Gatehouse playing L'Extase, by Thomé, and Godard's Berceuse de Jocelyn, the vocal items being contributed by Miss Carrie Tubb and Mr. Charles Corner. Among the guests were Colonel Stephenson, Majors Dumbleton and Erskine, Captain Simons, and Mr. Wordingham.

South African Notes.—A correspondent writes:—*Harrismith.*—The electric lighting plant, which has been installed at a cost of £16,000, was formally opened recently, when the Mayoress, Mrs. Caskie, switched on the light. Speeches were made congratulating the municipality on the inauguration of the scheme. The Mayor announced that they knew beyond doubt that the undertaking would pay from the start. The light has been freely adopted, and it is hoped locally that the military authorities will be induced to take the current for lighting the cantonments on King's Hill.

Kimberley.—The township of Beaconsfield was lighted by electricity on October 30th, the power being supplied by the De Beers Co. After the lights were switched on, the Town Council met some of the directors of the De Beers in the Chamber, and a few speeches of a congratulatory character were made.

Pretoria.—The Government has agreed to introduce a Bill to permit of the T.C. purchasing the Electric Light Co.'s assets.

Gwelo.—A local correspondent points out that there is a good opening locally for an electric lighting venture similar to that in operation in Victoria.

London County Council.—At the meeting on Tuesday it was decided to sanction the borrowing by Hampstead Borough Council of £27,340 for electric lighting purposes.

The Highways Committee reported the completion of the purchase of property in East Hill, Wandsworth, as a site for the erection of a sub-station for the working of the tramways in Battersea and Wandsworth. It was decided to enter into an agreement, particulars of which were recently given, with the North Metropolitan Tramways Co. for the working of the proposed tramway along Rosebery Avenue.

The Royal Society.—The *Times* states that a donor, who desires to remain anonymous, has placed a sum of £1,000 in the hands of the treasurer of the Royal Society, to be devoted to the advancement of science. By his wish £500 of this gift is to be placed to the credit of the "Catalogue of Scientific Papers Account" of the Royal Society, and the remainder to the credit of the "National Physical Laboratory Account" of that body, with the request that the Executive Committee of the Laboratory will accede to any personal wish of the director as to its expenditure.

Yesterday a paper was to be read by Dr. M. Wilderman on "Galvanic Cells produced by the Action of Light." (Preliminary communication, communicated by Dr. L. Mond, F.R.S.)

Papers and Lectures.—At a recent meeting of the Leeds University Engineering Society, Mr. G. H. Attock brought forward the subject of "French Foundry Practice."

Under the auspices of the Dundee Society of Experimental Engineers, Mr. Wm. C. Martin, Glasgow, on Tuesday last week, delivered a lecture in Dundee Y.M.C.A. Hall on "Electrical Appliances."

Before the Nottingham Guild of Mechanical and Electrical Engineers last week, Mr. William Chilton, of the Brush Electrical Engineering Co., Ltd., Loughborough, delivered an interesting lecture entitled "The Steam Turbine."

Engineers' Concert.—A concert of the Engineers' Club was held at the Café Monico, Shaftesbury Avenue, on Saturday evening last.

The Gas Exhibition.—It is only right and proper that those who are interested in the supply of electricity should, in view of increasingly keen rivalry, make themselves acquainted as far as possible with the doings of gas suppliers and others who are helping to forward the interests of gas as an illuminating agent. Therefore a visit of some interest to such men, and one which might prove profitable, ought to be made to the International Gas Exhibition, which was opened on Saturday last at Earl's Court, and will remain open until Saturday, December 17th. The Exhibition has been arranged under the auspices of the Institution of Gas Engineers. Among the exhibits will be found an interesting show of coal conveying and elevating machinery by Messrs. Graham, Morton & Co., Ltd., of Leeds.

Engineering Training.—A correspondent writes:—"The following is taken from the *Newcastle Daily Chronicle*, dated 14th inst.:—

THE ARMSTRONG COLLEGE.

A Leeds Engineering Firm's Offer.

The attention of local employers is called to the offer made by a Leeds firm, in connection with the engineering department of the Armstrong College of Science, in Newcastle. The communication is from the firm of Graham, Morton and Co., Ltd., contractors and engineers, contractors to the Admiralty and the War Office, Hunslet (Pepper Road), Leeds, and is as follows:—"Recognising, as we do, the importance of the movement in the great centres of education, which has for its aim the combination of practical with theoretical training for our young men attending British universities, we are pleased to offer to such as have obtained the B.Sc. in engineering, a two or three years' course in practical work in our drawing office. We are also prepared to pay a small remuneration, commencing at 15s. per week first year, 20s. per week second year, and £2 per week third year, to applicants appointed to the vacancies that may from time to time occur here."

We trust that this example will be widely followed. The gap between college and workshop is one of the most serious obstacles to be overcome by young would-be engineers.

Junior Institution of Engineers.—In his presidential address on "Municipal Engineering on the Continent," delivered to the Institution on November 18th, Mr. W. H. Lindley dealt mainly with the personal experiences of his father and himself, as they had stood for the last 60 years in the midst of this development. After describing the important water supply and sewerage works with which they had been connected, he proceeded to the third division of his address, the supply of towns with electrical energy. The commencement was made by the Berlin Works in 1885, which had now attained a capacity of 61,000 KW., producing 100,000,000 KW.-hours per annum. These were followed by Elberfeld in 1887, the first municipal electric supply station. He then proceeded to describe the Elberfeld Works, which were visited on the occasion of the summer excursion of the Institution last August. These works were extended on the alternating current system in 1898 under his direction and according to his plans. The further developments were as follows:—The raising of the pressure from 3,000 to 4,000 volts, and limiting the drop of pressure in the primary feeders of the network to 2½ per cent., and in the secondary network to 1½ per cent., thus allowing large quantities of energy to be supplied at any point of the district without injuriously affecting the voltage and the light. The adoption of the Parsons steam turbine in large units of 1,250 KW. had resulted in great economy. Mr. Lindley drew attention to the fact that for the Elberfeld station the working expenses (interest on capital and sinking fund excluded) per kilowatt-hour supplied had been brought down to 0·7d., and the coal consumption per kilowatt-hour to 2·65 lbs.

Appointments Vacant.—Resident electrical engineer for Farnworth U.D.C. (£200). *Indian Engineering* reports that the Secretary of State for India has sanctioned the creation of the appointment of electrical adviser to the Government of India on Rs. 1,000—50—1,600 per mensem, whose headquarters will be at Calcutta. The present post of electrical engineer to the Government of Bengal will be abolished.

Competition with Electricity.—The London and North-Western Railway Co. have a curious method of competing with the electric cars. Since the latter started to run between Manchester and Stockport, the railway company have apparently decided to punish the passengers, and to effect this desirable end, they have so reduced their trains, and changed the nature of their service, that passengers find it extremely awkward and inconvenient to travel by train from, say, Wilmslow to Manchester. So now the Wilmslow passenger travels only to Stockport, there shakes off the dust of the railway from their shoes—or clogs—and hies up a few yards to the tramway which carries him to Manchester for less money than the railway charges. By the little walk at Stockport, he saves a certain walk in Manchester, for the electric cars carry him far past the somewhat outlying railway terminus. Passengers having begun to use the electric cars occasionally, the railway has practically invited them to do so still more frequently, and the electric car habit is becoming by use and familiarity second nature. It does not seem to have suggested itself to the railway company that had they doubled the number of their trains, reduced their bulk and done something to differentiate their deliberate trundle more widely from the ox wagon, they might have reaped such a reward in increased traffic that they could well have spared the few who went over to the tramway. It is a marvel that suburban services have so long been looked on as proper to be worked by the decrepit engines and worn-out carriages no longer fit for main line duty. Suburban traffic has been kept down by excessive charges. If railway companies would base their charges more in accordance with *avoir du poids*, and less on the basis that passengers are immortal souls of great value, it is probable that their traffic would

grow to much larger proportions. Looked on as goods, passengers automatically load and unload themselves free of cost to the company. The present scale of railway charges is undoubtedly high. The occasional weekly cheap trains of the S.E. Railway, for example, show by their crowded state that a more frequent cheap service would pay well. People will not otherwise travel.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the power station or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*]

Central Station Engineers.—The Marylebone Electric Supply Committee has made the following appointments:—Mr. T. G. BACON, at present electric inspector to the Borough Council, to be a house service inspector; Mr. F. SELLEY, formerly installation and meter inspector to the Walthamstow Urban District Council, to be installation and meter inspector.

Mr. J. R. W. GRAINGE, shift engineer, Battersea electrical undertaking, has resigned his appointment, and has been appointed assistant electrical engineer by Erith U.D.C.

Mr. F. P. FLETCHER, shift engineer to the Fulham Borough undertaking, has been appointed chief assistant at Woolwich.

Mr. A. S. GILES, who retires at the end of this month from the position of tramways manager and electrical engineer to the Blackburn Corporation, received on Saturday farewell gifts from the staffs of both departments. On behalf of the electricity staff, Ald. Thompson, chairman of the Committee, presented Mr. Giles with a rose bowl of silver, suitably inscribed, together with a silver matchbox and an enamelled miniature of the borough arms. He bore testimony to the able manner in which Mr. Giles had discharged his duties, and wished him every success in his new post in South Africa. Mr. P. P. WHEELWRIGHT, who succeeds Mr. Giles as chief engineer, said the whole staff regretted Mr. Giles's departure. The gift from the tramways staff—a silver tea service and tray—was presented by Councillor A. Nuttall, vice-chairman of the Committee. Mr. J. H. Cowell and Mr. L. Johnston, the newly appointed joint managers of the tramways, Mr. J. W. Baker, the chief clerk, and Mr. W. Thomas, representing the car drivers, spoke of the good feeling between the staff and their retiring chief. Mr. Giles suitably replied.

Mr. J. D. PEMBER, A.M.I.E.E., electrical engineer and tramway manager to the Urban District Council of Farnworth, has been appointed electrical engineer to the Dartford Urban District Council, at a commencing salary of £250 per annum. There were 159 applications for the appointment.

Mr. C. WYATT, A.I.E.E., is leaving the County of London Electric Supply Co. to take up the position of assistant engineer in the distribution department of the Borough of Croydon.

Mr. W. G. RITCHIE, assistant mains superintendent, Leith Corporation electricity department, was, on Thursday, 17th inst., presented with a gold-chased fountain pen, from the members of the staff, on the occasion of his leaving, after five years' service, to take up the appointment of mains superintendent to the National Electrical Construction Co., Ltd., Musselburgh.

On 15th inst. the Chester Lighting Sub-Committee reduced the 118 applications received for the appointment of station superintendent to four, namely:—Mr. W. Alstone, Bermondsey Electricity Works; Mr. J. Christie, Glasgow Electricity Works; Mr. P. Heard, Westminster Electric Supply Corporation; Mr. A. Johnson, Burnley Electricity Works. On 23rd inst. the full Committee met and interviewed the above applicants, and subsequently appointed Mr. P. HEARD.

Tramway Officials.—At a meeting of the Bury Corporation Tramways Committee last week, Mr. WILLIAM CLOUGH was appointed manager of the borough tramways at a salary of £250 a year. Mr. Clough has filled the position temporarily for 12 months.

Mr. J. C. MCMAHON, of Blackpool, has been appointed deputy manager of the Northampton Corporation tramways.

The Birkenhead Corporation Tramways Athletic Club held its second social evening on Friday last, Mr. W. Wyld, the general manager, presiding. There were more than 100 present. A large and varied programme was performed, the employés being responsible for many musical and vocal items.

General.—Messrs. James Howden & Co., of Glasgow, have appointed Mr. W. H. OWEN (who has for some time occupied a responsible position on the staff of their dynamo engine and turbine department) to represent them in London in succession to Mr. F. C. Gibbons. Mr. Owen has now taken up his duties at their London office, Billiter Buildings, 22, Billiter Street, E.C.

The employés of Messrs. W. J. Furse & Co., electrical engineers, of Nottingham, held a social evening on Wednesday, November 16th. The object of this gathering was to make a presentation to Mr. BROWNELL, who for about 11 years has occupied the position of superintending engineer with the firm, and is now about to leave to take up an appointment with the Corporation of Durban, South Africa. Mr. Brownell was presented by Mr. Furse on behalf of himself and employés with a gold watch and illuminated address. He was also the recipient of a handsome silver cigarette case, the personal gift of Mr. Furse. Several speeches of a complimentary character were made, and music and song were rendered during the evening.

Mr. JOSEPH BASTICK, of Limerick, is now living in England—at Garston, Liverpool—and will hold the position of non-residential consulting engineer to Messrs. Henson & Co., Askeaton Carbide Works, Askeaton, co. Limerick.

ELECTRICITY SUPPLY ACCOUNTS.

Wimbledon Municipal Electricity Supply.

THE expectation of a good year, which the progress of previous years had justified, has been fully realised by the Wimbledon Electrical Department, which this year eclipsed all previous records. With improvements both in average revenue and in working costs, the surplus, after meeting financial charges, amounts to nearly £3,000, as against £2,000 in the previous year.

It will be noted that the private supply is now considerably in excess of that for public lighting, which would account for the increased average revenue. The system of charging is being gradually simplified, the maximum demand having given way to a sliding scale, and it is rumoured that this will eventually find a successor in a simple flat rate. We congratulate the engineer on the very progressive results obtained.

The prices charged are:—Private lighting, 5d. and 3½d. per unit on a sliding scale; power, 2d. per unit; and public lighting, 3d. The chief engineer is Mr. H. Tomlinson Lee.

GENERAL STATEMENT.

For year ending March 31st—	1904.	1903.
Total capital expended	£115,746	£100,202
Number of units sold—		
Private supply	653,305	500,846
Public lighting	539,673	511,152
Total number of units sold ...	1,192,978	1,011,998
Equivalent No. of 8-C.P. lamps connected...	66,925	53,967
H.P. of motors connected	307	—
Number of public lamps	1,110	1,091
Maximum load in KW.	772	603
Revenue account—		
Gross revenue	£18,640	£15,472
„ expenditure	£9,347	£8,365
„ profit	£9,293	£7,107
Average price obtained per unit—		
Private lighting	4·46d.	4·62d.
Public lighting	2·66d.	2·54d.

REVENUE ACCOUNT FOR YEAR ENDING MARCH 31ST, 1904.

Gross revenue	£18,640 = 3·76d. per unit.
Works and distribution costs (including public lighting)	£7,060 = 1·42d. „
Total working costs	£9,347 = 1·88d. „

PROFIT STATEMENT, 1904.

Interest on loans, &c.	£3,156
Sinking fund	2,992
Sundry expenses	205
Balance on year's working	2,940
Gross profit	£9,293

CITY NOTES.

Cape Electric Tramways.

THE eighth ordinary general meeting of this company was held on Wednesday at 1, London Wall Buildings.

Sir CHARLES EUAN-SMITH, the chairman, said that, notwithstanding the almost universal depression during the year, and especially in South Africa, the tramway systems of Capetown and Port Elizabeth had more than maintained their previous excellent record of traffic dealt with and revenue earned. Taking the two systems together, there had been an increase of 773,012 in the number of passengers carried, and an increase of £3,262 in the revenue. The board had been enabled to pay two interim dividends of 5 per cent. each, making 10 per cent. for the year. It was too early to make any forecast as to the current year, but considerable

expenditure has still to be faced before the entire track, which had been in use for 10 years, can be thoroughly renewed. They had also to face two new items of expenditure, namely, under the Cape Colony new Income-Tax Act, and the increased mileage tax on the metropolitan tramways which would come into force—these two items together aggregating about £8,000.

The report was adopted.

West India and Panama Telegraph Co.

The directors' report for the half-year ended June 30th, 1904, to be submitted to the meeting on November 30th, reads as follows:—

The directors submit the accounts for the six months ended June 30th, 1904. The amount to credit of revenue is £34,581 11s. 7d., against £34,903 10s. 11d. for the corresponding half-year of 1903. The expenses have been £23,487 14s. 3d., against £23,051 14s. 2d., leaving a balance of £11,143 17s. 4d., to which is added £1,825 1s. 8d. interest on investments, and £710 15s. 1d. brought from last account, making a total of £13,679 13s. 8d., with which it is proposed to deal as follows:—

Payment of 7s. per share on account of arrears of dividend to June 30th, 1904, on the first preference shares	£12,097	1 0
Balance to current half-year's account	1,582	12 8
	£13,679	13 8

This will leave the following dividends in arrear:—

On the first preference shares	£1,728	3 0
On the second preference shares	11,205	12 0
	£12,933	15 0

The expenses of repairing cables during the half-year amounted to £8,539 12s. 9d., being £1,211 17s. 4d. less than that for the corresponding period. This is, however, exclusive of a further expenditure of £3,467 18s. 2d., which has been charged to reserve in respect of 40 knots of new cable used in February last in the repair and partial renewal of the St. Lucia-St. Vincent section, which, it will be remembered, was interrupted by volcanic disturbances in September, 1902. The company's repairing steamer *Henry Holmes* was chartered to the Cuba Submarine Telegraph Co. in September last to repair one of their cables, but the charter has expired since, and the ship has resumed her ordinary work on the company's system. The directors are pleased to report that the Danish colonies of St. Thomas and St. Croix have renewed their subsidies for a further term of five years. West India commercial prospects are reported to be favourable, consequent upon the abolition of the sugar bounties. The improvement to be expected therefrom has, however, not had time to make itself felt in the traffic receipts of the company.

Aron Electricity Meter, Ltd.

The report for the year ended September 30th, 1904, shows that after providing for general charges, depreciations and share of expenses and discount on the issue of debentures, there is a net profit of £10,680. Of this £4,645 is applied to removing from the balance-sheet the trading loss of the year 1901-2; £2,500 is set aside for debenture sinking fund; £3,122 is applied to the payment of 2½ per cent. on account of the preference dividend in arrear, and £412 is carried forward. The business in England has assumed a brighter aspect. The new alternating current motor-meter recently introduced, and other new inventions are meeting with favour.

Stock Exchange Notices.—Applications have been made to the Committee to appoint a special settling day in and to grant a quotation to:—

Telephone Co. of Egypt, Ltd.—£60,000 4½ per cent. debenture stock.
Calcutta Electric Supply Corporation, Ltd.—Further issue of 20,000 ordinary shares of £5 each, £3 paid, Nos. 60,001 to 80,000.
Henley's (W. T.) Telegraph Works, Ltd.—Further issue of 5,000 4½ per cent. cumulative preference shares of £5 each fully paid, Nos. 35,001 to 40,000.

Geneva Tramways Co.—The report for the year ended September 30th states that, owing to the inability of the Compagnie Genevoise des Tramways Electriques to pay any dividend on its capital with which to meet this company's indebtedness, the revenue account of this company shows a loss of £42,354, increasing the amount standing to the debit of revenue account to £117,288, mainly the result of the accumulation of unpaid interest on the debenture issues.

Richard Hornsby & Sons, Ltd.—The directors recommend a dividend for the year ended September 30th last at the rate of 6s. per share on the ordinary shares, free of income-tax, placing £3,000 to reserve account, and carrying forward £1,708. Last year the dividend was 8s. per share, making 5 per cent. for the year, £5,000 being placed to reserve, and £1,443 carried forward.

STOCKS AND SHARES.

Wednesday Evening.

Though business in the Stock Exchange is somewhat irregular—good one day and quiet on the next—the volume of orders, on the whole, shows a satisfactory expansion. Politics as a market factor have fallen into a less aggressive attitude, and money remains abundant. If the Bank Rate should rise to 4 per cent., nobody could plead astonishment as a reason for putting down prices, and an advance in the minimum is now too well anticipated for its event to cause much disturbance. In the electric departments, telegraph issues are fairly active, and while the regalvanised Anglo-American group has a series of falls to exhibit on balance, there is a lot of business doing in all the issues.

Several appeals for capital are in the market, and last week we gave the salient particulars of the Hastings and District Tramways issues. The careful investor is hardly likely to have sent in subscription to either the Debenture stock or the Preference shares. On the other hand, the new Edmundson's shares now offered to the proprietors in the company will probably be avidly taken by those who have the right to apply. Maybe the directors are asking rather a high price in fixing £5 15s. per share for both Ordinary and Preference, and as the issue came earlier than most people expected, the existing shares relapsed sharply. The new 20,000 are guaranteed, however, and shareholders can apply for them without hesitation. Another interesting issue is a new 3½ per cent. convertible Preference, which the Metropolitan Railway is said to be on the point of offering to its proprietors at 104 per cent. In view of the success attendant upon the last emission of convertible Preference, it may be presumed that the current stock will receive a cordial welcome. A nominal premium of about 2 per cent. has already been established.

Metropolitan Consolidated dipped a little upon the new issue, and is now 100½, Districts also being easier at 42, since there appears to be a prospect of the electrification taking longer than some people had supposed. A revival in Great Northern and City Preferred shares has left the quotation unchanged at 5⅝, but there is a good deal being done in the shares, and as a speculative investment, they are not to be despised. Central Londons retain their improvement of a week ago, and the other electric stocks have continued motionless. East Londons are back to 5⅜, a 10s. fall taking place upon a falling off in the recently-accorded support. At 99¼ Underground profit-sharing notes are a shade better.

There is not much doing in Traction shares, unless we include the buying of London General Omnibus stock and Road Car shares, possibly due to the favour with which both companies' motor services have been received by the public. This may, of course, be partly in consequence of the novelty of the new conveyances, but as the latter are swift and comfortable, they may become a new source of competition to the Tubes in course of time. British Electric Traction Preference have again declined, and a loss of ¼ makes the price 10⅞, the Ordinary continuing at 10. The company's Second Debenture at 96 is a trifle harder. Metropolitan Electric Tramway shares have come into some demand, as a result of the advance in the Debenture stock, and the Ordinary are up to 8s, the Preference being a pound. Anglo-Argentine Preference at 5½ have put on 1/16, and Buenos Ayres and Belgrano "A" followed with ⅛ rise to 5⅞. The "B" Preference are 5¼, but the Ordinary drooped to 3⅞. Auckland Debenture is now 106, or eight points higher than it stood when its attractions were discussed here some time ago. Capes are ⅛ lower at 1 9/16 on the meeting. British Westinghouse Preference and Debenture keep steady at 3½ and 90 respectively, while British Thomson-Houston stands at par.

Mention has already been made of the set-back in Edmundson's shares. The Ordinary are ⅜ down to 5⅞, and at the same price the Preference show ⅛ loss. Therefore, the margin of difference between these prices and that of the new issue is very narrow. Urban Ordinary added 1/16, bringing its quotation level with that of the Preference shares—*i.e.*, £5. Charing Cross New Ordinary are 8¼. Electric Construction Preference have hardened to 2⅜ middle. Cromptons are now called 1½—1⅝. Brush Ordinary hardened ¼ to 10s.

After their feverish jump, Anglo-American Telegraph stocks are settling down, but the prices have been well sustained in the circumstances. The Preferred shows a drop of 2 points to 102, the Deferred is ⅜ down at 11⅞, and the Ordinary lost a point at 56. Submarine Cables found support in New York, and the price has advanced to 120½, although Commercial Cable Debenture eased off 1 per cent. to 93½. Demand for Cuba Telegraphs took the Ordinary to 8 and the Preference to 15½, it being stated that the island is getting into a swing of new prosperity, fostered by the introduction of large amounts of United States capital. Direct United States shares at 10⅞ have gained another 2s. 6d., and there is further improvement in West India and Panama Telegraphs on account of the dividend on the First Preference. The Far Eastern group displays ¼ rise in "China" shares to 13⅛, but Great Northerns at 28½ have slipped back to the extent of the fraction, last week's seller being still in the market. Globe Telegraph and Trust of both kinds are unchanged. A point rise leaves Telegraph Construction shares at 39. Amazons slumped on the appearance of a seller in a market void of any demand. National Telephone Preferred is being bought by reason of the yield obtainable, and at 107½ marks 10s. improvement. Other telephone issues have not moved.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1901.	1902.	1903.	Closing Quotations Nov. 16th.	Closing Quotations Nov. 23rd.	Business done week ended Nov. 23rd, 1904. Highest	Lowest
67,100	African Direct Telegraph, 4 % Debs.	100	..	..	..	99 —102	99 —102	..	..
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	..	..	..	2⅛— 3	1 — 1½	..	..
119,700‡	Do. do. 5 % Debs., Nos. 1 to 1,950 Red.	100	..	..	..	.. — ..	.. — ..	..	..
788,840	Anglo-American Telegraph	Stock	61s.	60/6	61s.	56 — 58	55 — 57	56⅛	..
3,105,580	Do. do. do. 6 % Pref.	Stock	6 %	6 %	6 %	103 — 105	101 — 103	103¼	102½
3,105,580	Do. do. do. Deferred	Stock	2s.	1/-	2s.	12⅛— 12⅜	11⅜— 12	13½	11⅞
44,000	Chili Telephone, Nos. 1 to 44,000	5	5 %	6 %	7 %	5⅝— 5⅞	5⅝— 5⅝	5⅝	..
13,333,300$	Commercial Cable	$100	8 %	8 %	..	170 —190	170 —190	..	..
1,841,209	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	..	..	..	93 — 96	92 — 95	94	93
16,000	Cuba Telegraph	10	4 %	6⅔%	5 %	7½— 7⅞	7⅞— 8⅛	8⅛	7⅞
6,000	Do. 10 % Pref.	10	..	..	..	14½— 15½	15 — 16	15½	..
6,000	Direct Spanish Telegraph10 % Cum. Pref.	5	..	..	..	7½— 7⅝	7⅝— 7⅞	7 11/16	7 7/16
80,000	Do. do. 4½ % Debs.	50	..	..	..	99 —101	99 —101	..	..
60,710‡	Direct United States Cable	20	3½%	3½%	3 %	10⅜— 10⅝	10⅜— 11	11 1/16	10½
81,800	Direct West India Cable, 4½% Reg. Deb., within Nos. 1 to 1,900, Red.	100	..	..	..	100 —102	100 —102	..	..
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	133 —136	133 —136	134⅜	133½
1,955,565	Do. 8½ % Pref. Stock	100	..	..	..	88 — 90	88 — 90	88½	88⅜
1,584,645	Do. 4 % Mort. Deb. Stock Red.	Stock	..	..	..	105 —107	105 —107	106⅝	105½
800,000	Eastern Extension, Australasia, and China Telegraph	10	7 %	7 %	7 %	12⅞— 13⅛	13 — 13½	13½	13
800,000‡	Do. 4 % Deb. Stock	Stock	..	..	..	106 —108	106 —108	..	..
800,000	Eastern & South African Tele., 4% Mt. Db., Nos. 1 to 8,000, red. 1909	100	..	..	..	101 —103	101 —103	101⅛	101
200,000‡	Do. do. 4 % Reg. Mort. Debs. (Mauritius Sub.) 1 to 8,000	25	..	..	..	100 —102	100 —102	100	..
180,227	Globe Telegraph and Trust	10	5½%	£3 16 7*	5½%	9½— 10	9½— 10	10	9 9/32
180,042	Do. do. 6 % Pref.	10	..	..	..	13½— 14	13½— 14	13 13/32	13⅜
150,000	Great Northern Telegraph, of Copenhagen	10	15 %	12½%	15 %	28¼— 28¾	28 — 28½	28⅝	28
54,700	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	..	..	..	100 —102	100 —102	..	..
17,000	Indo-European Telegraph	25	10 %	10%	10 %	44½ — 46½	44½ — 46½	..	..
72,680	Monte Video Telephone Co., Ltd., Ord.	1	2½%	3 %	3 %	⅜— 7/16	⅜— 7/16	..	..
1,968,888	National Telephone, Pref. Stock	100	5 %	6 %	6 %	106½ —107½	107 —108	108	107
1,966,667	Do. do. Def. Stock	100	..	4½%	5 %	96½ — 97½	96½ — 97½	97½	96⅝
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	13 — 14	13 — 14	..	..
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	12 — 13	12 — 13	..	..
2,250,000	Do. do. 5 % Non-cum. 3rd. Pref., 1 to 250,000	5	5 %	5 %	5 %	5½— 5⅝	5½— 5⅝	5⅝	..
000,000‡	Do. do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	97⅛ — 98⅛	97⅛ — 98⅛	98⅛	97⅛
689,593	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	104½ —105½	104½ —105½	105½	104⅝
1,000,000	Do. do. Prov. Certs., 35 % to be paid	..	..	..	..	67½ — 68½	67½ — 68½	..	..
179,313	Oriental Telephone and Elec. Nos. 1 to 171,504, fully paid	1	6 %	6 %	6¼%	1 1/16 — 1 1/8	1 1/16 — 1 1/8	..	..
50,000	Do. do. do. 6 % Cum. Pref.	1	..	..	..	1⅛— 1¼	1⅛— 1¼	..	..
100,000‡	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000	100	..	..	..	98 —100	98 —100	..	..
11,689	Reuter's	8	5 %	5 %	..	6⅞— 7⅛	6⅞— 7⅛	..	..
3,808	Submarine Cables Trust	Cert.	..	..	..	118 —120	119 —122	..	..
58,000	United River Plate Telephone	5	7 %	7 %	..	6⅞— 6⅞	6⅞— 6⅞	..	..
40,000	Do. do. 5 % Cum. Pref., Nos. 1 to 40,000	5	..	..	..	5⅛— 5⅜	5⅛— 5⅜	5⅜	..
179,947‡	Do. do. 5 % Debs.	Stock	..	..	..	104 —106	104 —106	..	..
15,609	West African Telegraph, Shares	10	..	2 %	4 %	7 — 7½	7 — 7½	..	..
80,008	West Coast of America, 1 to 30,000 and 53,001 to 53,008	2½	..	..	..	⅜— ½	⅜— ½	..	..
150,000‡	West Coast of America, 4% Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	..	..	..	98 —100	98 —100	..	..
267,880	Western Telegraph, Ltd., Nos. 1 to 267,880	10	7 %	7 %	7 %	13⅛— 13⅜	13⅛— 13⅜	13⅜	13⅛
75,000‡	Do. do. 5 % Debs. 2nd series, 1906	100	..	..	..	101½ —103½	101⅛ —103⅛	..	..
400,000	Do. do. 4 % Deb. Stock Red.	100	..	..	..	101⅛ —103⅛	101⅛ —103⅛	..	..
88,321	West India and Panama Telegraph	10	..	..	..	3/16 — 5/16	1/16 — 3/16	..	1/16
84,563	Do. do. do. 6 % Cum. 1st Pref.	10	..	..	..	7⅛— 7⅜	7⅛— 7⅜	7⅜	7⅛
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	..	..	..	5⅛— 6	6 — 6	..	..
80,000‡	Do. do. do. 5 % Debs., Nos. 1 to 1,600	100	..	..	..	102 —104	101 —103	..	..

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

20,000	British Aluminium 7 % Cum. Pref.	10	..	..	..	5⅜— 5½	5⅜— 5½	5⅝	..
10,000	Do. do. "A" 6 % Cum. Pref.	10	..	..	..	8⅜— 9	8⅜— 9⅜	8⅜	..
800,000‡	Do. do. 5% 1st Mort. Deb. Stock Red.	Stock	..	..	..	96 — 100 xd	96 — 100 xd	..	..
100,000	British Electric Traction	10	9 %	8 %	..	9⅜— 10⅛	9⅜— 10⅛	10⅛	9⅜
100,000	Do. do 6 % Cum. Pref.	10	..	..	..	11 — 11½	10⅜— 11	11	10 13/16
600,000‡	Do. do. 5 % Perpetual Debenture Stock	Stock	..	..	..	117 —119	117 —119	118⅜	117⅛
	Do. do. 4½% 2nd Deb. Stock Red.	100	..	..	..	94 — 97	95 — 97	96⅛	..
100,000	British Insulated and Helsby Cables	5	10 %	10 %	8 %	5⅛— 6	5⅛— 6	..	..
100,000	Do. do. 6 % Cum. Pref.	5	..	..	..	5⅝— 6	5⅝— 6	..	..
50,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	..	..	..	101 —104	102 —105	..	..
50,000	¶Browett, Lindley & Co., Ord.	£1	Nil	..	..	⅜— ⅝	⅜— ⅝	..	..
50,000	¶ Do. do. 6 % Cum. Pref.	£1	6 %	..	..	14/6 to 15/6	14/6 to 15/6	..	..
105,781	Brush Electrical Engineering, Ord., 1 to 105,781	2	Nil	Nil	Nil	½— ⅝	⅜— ⅝	..	..
150,000	Do. do. Non-cum. 6 % Pref.	2	3 %	6 %	6 %	1 — 1½	1 — 1½	1⅛	..
125,000‡	Do. do. 4½ % Perp. Deb. Stock	Stock	..	..	..	93 — 96	93 — 96	..	..
125,000‡	Do. do. 4½ % Perp. 2nd Deb. Stock	Stock	..	..	..	69 — 73	69 — 73	..	..
35,000	Callender's Cable Construction shares	5	20 %	15 %	12½%	9½— 10	9½— 10	9¾	..
40,000	Do. do. do. 5 % Cum. Pref.	5	..	..	..	5 — 5½	5 — 5½	5½	..
90,000‡	Do. do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	..	..	..	104 —106	104 —106	104½	..
1,360,014	Central London Railway, Ord. Stock	Stock	4 %	4 %	4 %	93 — 95	93 — 95	95	93½
494,098	Do. do. 4 % Pref. Stock	Stock	4 %	4 %	4 %	101 —103	101 —103	..	..
494,998	Do. do. Def. do.	Stock	4 %	4 %	4 %	84 — 86	84 — 86	..	..
1,190,000	City and South London Railway	Stock	2 %	3½%	2½%	46 — 47	46 — 47	47	46⅜
85,000	Crompton & Co., Nos. 1 to 85,000	5	7½%	6 %	..	1½— 2	1½— 1⅝	1 7/16	..
100,000‡	Do. 5 % 1st Mort. Reg. Debs., to 900 of £100, and 901 to 11,000 of £50 red.	..	..	..	..	90 — 95	90 — 95	..	..
99,261	Edison & Swan United Elec. Light, "A" shares, £8 paid, 1 to 99,261	5	Nil	Nil	..	½— ¾	½— ¾	..	..
17,139	Do. do. "A" shares, 01—017,139	5	Nil	Nil	..	1 — 1½	1 — 1½	..	..
314,022‡	Do. do. 4 % Deb. Stock Red.	100	..	..	..	78 — 83	78 — 83	..	..
100,000‡	Do. do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	..	..	..	79 — 84	79 — 84	..	..
112,100	Electric Construction 1 to 112,100	2	6 %	6 %	4 %	1½— 1¾	1½— 1¾	..	..
31,890	Do. do. 7 % Cum. Pref., 1 to 31,890	2	..	..	..	2⅛— 2⅜	2⅛— 2⅜	2 1/16	..
84,500‡	Do. do. 4 % Perp. 1st Mort. Deb. Stock	Stock	..	..	..	98 —100	98 —100	98½	98½
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	..	9½— 10	9½— 10	..	..
200,000	Do. do. 4 % Mort. Deb.	Stock	..	..	..	91 — 96	91 — 96	..	..
200,000	Henley's (W. T.) Telegraph Works, Ord.	5	20 %	20 %	15 %	10⅜ - 11⅛	10⅜ - 11⅛	..	..
200,000	Do. do. 4½ % Pref.	5	..	..	..	5⅛ — 5⅜	5⅛ — 5⅜	..	..
45,900	Do. do. 4½ Mort. Deb. Stock	Stock	..	..	..	109 —111	109 —111	..	..
50,000	India-Rubber, Gutta-Percha & Telegraph Works	10	10 %	10 %	..	20 — 20½	20 — 20½	20 1/16	20
800,000‡	Do. do. do. 4 % 1st Mort. Deb.	100	..	..	..	99 —102	99 —102	..	..
97,500	†Liverpool Overhead Railway, Ord.	10	1½%	1½%	..	3⅜— 3⅝	3⅜— 3⅝	..	..
10,000	† Do. do. Pref. £10 paid	10	..	..	..	10 — 10½	10 — 10½	..	..
87,850	Telegraph Construction and Maintenance	12	20 %	20 %	20 %	37 — 39	38 — 40	38⅞	38½
150,000‡	Do. do. 4 % Deb. Bds., Nos. 1 to 1,500 Red. 1909	100	..	..	..	104 —104	103 —104	..	..
540,000‡	Waterloo & City Railway, Ord. Stock	100	8 %	8½%	8½%	88 — 90	88 — 90	88½	88

* A period of nine months. † Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ From Manchester Share List

Bank rate of discount 3 per cent. (April 21st, 1904).

SHARE LIST OF ELECTRICAL COMPANIES (continued) — *ELECTRICITY SUPPLY COMPANIES.

Present issue.	NAME.	Stock or Share.	Dividends for the last three years 1901.	1902.	1903.	Closing Quotations Nov. 16th.	Closing Quotations Nov. 23rd.	Business done week ended Nov. 23rd, 1904. Highest.	Lowest
20,000	Brompton & Kensington Electric Light Sup., Ord., 1 to 20,000 ..	£	8%	8 %	10 %	10¼— 11	10¼— 11	..	..
20,000	Do. do. 7 % Cum. Pref. ..	£	..	..	..	10¼— 10¾	10¼— 10¾	..	..
250,000	Central Electric Supply 4 % Guar. Deb. Stock	100	..	..	..	106 —109	106 —109	108¼	..
50,000	Charing Cross and Strand Electricity Supply	£	10 %	10 %	8 %	8⅛— 9	8⅛— 9	..	..
70,000	Do. do. 4½% Cum. Pref. ..	£	..	..	..	5¼— 5¾	5¼— 5¾	5¾	5⅝
40,000	Do. do. "City Undertaking" 4½% Cum. Pref. ..	£	..	..	..	4½— 5	4½— 5	..	..
40,000	Do. do. 1903	£	..	..	..	4½— 5	4½— 5	4⅛	..
250,000	Do. do. 4 % Deb. Stock Red.	100	..	..	..	103 —105	103 —105	104½	104
44,436	*Chelsea Electricity Supply, Ord.	£	4 %	4½%	5⅛%	6⅛— 6¾	6⅛— 6¾	6⅞	6½
150,000£	Do. do. % Deb. Stock Red.	Stock	..	..	..	109 —111	109 —111	..	..
70,595	City of London Electric Lighting, Ord. 40,001—110,595 ..	£	5 %	5 %	5 %	10¼— 11	10¼— 11	..	..
40,000	Do. 6 % Cum. Pref., 1 to 40,000	£	..	..	..	13⅛— 14	13⅛— 14	13⅜	13⅛
400,000£	Do. 5 % Deb. Stock, Scrip. (iss. at 115) all paid ..	£	..	..	..	123 —127	123 —127	..	..
800,000	Do. 4½% 2nd Deb. Stock, Prov. Certs., all paid ..	100	..	..	..	104 —106	104 —106	104½	..
40,000	County of London Electric Lighting, Ord. 1—40,000	£	4 %	4 %	4 %	9¼— 9⅜	9¼— 9⅜	9	..
20,000	Do. do. do. 6 % Pref., 40,001—60 ..	£	..	..	..	12— 12½	12— 12½	12⅛	..
400,000£	Do. do. 4½% Deb. Stock	£	..	..	..	106 —109	107 —110	109	..
250,000	Do. do. 4½% 2nd Deb. Stock	Stock	..	..	..	101 —103	101 —103	101	..
70,000	Edmundson's Electric Corporation, Ord. Shares	£	7 %	7 %	7 %	6⅜— 6⅝	5⅞— 6	6⅛	5⅞
70,000	Do. do. 6 % Cum. Pref.	£	..	..	..	5⅞— 6⅛	5⅞— 6	6⅛	5⅞
300,000£	Do. do. 4½% 1st Mort. Deb. Stock ..	100	..	..	..	106 —108	106 —108	..	..
21,000	Kensington and Knightsbridge Electric Ord.	£	10 %	10 %	12%	12 — 13	12 — 13	..	..
90,000	Do. do. do. 4 % Debenture Stock ..	Stock	..	..	..	102 —104	102 —104	..	..
110,000	London Electric Supply Corporation, Limited, Ord.	£	..	..	..	2 — 2⅛	2 — 2⅛	2	..
49,840	Do. do. do. 6 % Pref.	£	..	..	..	5⅝— 5⅞	5⅝— 5⅞	5⅝	5⅝
250,000£	Do. do. do. 4 % 1st Mort. Deb. Stock Red	Stock	..	..	..	97 — 99	97 — 99	..	..
100,000	Metropolitan Electric Supply, 1 to 100,000	£	6¼%	7½%	8⅓%	16 — 16⅜	16 — 16⅜	16½	16¼
71,106	Do. do. 4½% Cum. Pref. 1—71,106, £3 paid ..	£	..	..	..	5⅜— 5⅝	5⅜— 5⅝	5⅞	..
220,000£	Do. do. 4½% 1st Mort. Deb. Stock	£	..	..	..	112 —117	112 —117	..	..
250,000£	Do. do. 3½% Mort. Deb. Stock Red	Stock	..	..	..	97 — 99	97 — 99	..	..
10,852	Notting Hill Electric Lighting	£	6 %	6 %	6 %	14¼— 15	14¼— 15	..	..
59,000	Do. do. 4% 1st Mort. Deb.	100	..	..	..	101 —103	101 —102	..	..
40,000	St. James' and Pall Mall Electric Light, Ord.	£	14¼%	14¼%	14¼%	14¼— 14⅝	14¼— 14⅝	..	..
20,000	Do. do. do. 7 % Pref. 20,081 to 40,080	£	..	..	..	8⅞— 9	8⅞— 9	..	..
150,000£	Do. do. do. 3½% Deb. Stock Red ..	100	..	..	..	99 —101	99 —101	..	..
12,000	Smithfield Markets Electric Supply, Ord.	£	..	2½%	4 %	2¾— 3⅛	2¾— 3⅛	..	..
50,000	Do. do. 4 % Deb. Stock	Stock	..	..	..	83 — 87	83 — 87	..	..
65,000	South London Electricity Supply, Ord.	£	..	1⅜%	3 %	4¼— 4⅜	4¼— 4⅜	4⅞	..
100,000	South Metropolitan Electric Light and Power (Ord.	£	..	..	..	⅞— 1	⅞— 1	..	..
50,000	(Late Blackheath and Greenwich 7 % Pref.	£	..	..	..	1⅛— 1⅞	1⅛— 1⅞	1⅜	..
100,000	Dist. E.L.Co.) 4½% 1st Deb. Stock	100	..	..	..	107 —110	107 —110	..	..
80,000	Urban Electric Supply, Ord.	£	..	..	..	4⅜— 5	4⅛— 5⅛	5	..
80,000	Do. do. 5 % Cum. Pref	£	..	..	..	4⅛— 5⅛	4⅛— 5⅛	5⅛	..
200,000	Do. do. 4½% 1st Mort. Deb. Stock Red ..	100	..	..	..	103 —105	103 — 105	105	104½
110,000	Westminster Electric Supply, Ord.	£	10½%	12 %	13½%	12⅜— 13⅛	12⅜— 13⅛	13⅛	12⅞
28,141	Do do. 5 % Cum. Pref.	£	..	..	..	6⅜— 7	6⅜— 7	6⅝	6⅛

* Subject to Founders Shares. ‡ Unless otherwise stated all shares are fully paid.

MARKET QUOTATIONS, Wednesday, November 23rd.

	CHEMICALS, &c.		Latest Price.	Week's Inc. or Dec.
a	Acid, Hydrochloric	per cwt.	5/-	..
a	,, Nitric	per cwt.	22/-	..
a	,, Oxalic	per cwt.	32/-	..
a	,, Sulphuric	per cwt.	5/6	..
a	Ammoniac, Sal	per cwt.	42/-	..
a	Ammonia, Muriate (crystal) ..	per ton	£33 10	..
a	,, ,, ...	per ton	£30	..
a	Bleaching powder	per ton	£5 5	..
a	Bisulphide of Carbon	per ton	£15	..
a	Borax	per ton	£18	..
a	Benzole (90 %)	per gal.	7/-	..
a	,, (50/90 %)	per gal.	5/6	..
a	Copper Sulphate	per ton	£23	£2 inc.
a	Lead, Nitrate	per ton	£25	..
a	,, White Sugar	per ton	£31	..
a	,, Peroxide	per ton	£27 10	..
a	Methylated Spirit	per gal.	2/6	..
a	Naphtha, Solvent (90% a 160° C).	per gal.	5/6	..
a	Potash, Bichromate, in casks ..	per lb.	3d.	..
a	,, Caustic (75/80%)	per ton	£24	..
a	Shellac	per cwt.	240/-	..
a	Sulphate of Magnesia	per ton	£4 10	..
a	Sulphur, Sublimed Flowers ..	per ton	£6 10	..
a	,, Recovered	per ton	£5 10	..
a	,, Lump	per ton	£5	..
a	Soda, Caustic (white 70 %) ..	per ton	£10 15	..
a	,, Crystals	per ton	£3	..
a	,, Bichromate, casks	per lb.	2½d.	..
	METALS, &c.			
b	Aluminium Ingots, in ton lots ..	per ton	£130	..
b	,, Wire, in ton lots ..	per ton	£168	..
b	,, Sheet, in ton lots ..	per ton	£166	..
b	Babbitt's metal ingots	per ton	£48 to £140	..
	Brass (rolled metal 2" to 12", basis	per lb.	7¼d.	..
c	,, Tube (brazed) ..	per lb.	9¼d.	..
c	,, ,, (solid drawn)	per lb.	8¾d.	..
c	,, Wire, basis	per lb.	7¾d.	..
c	Copper Tubes (brazed)	per lb.	10d.	..
c	,, ,, (solid drawn) ..	per lb.	10½d.	..
c	Copper Bars (best selected	per ton	£81	£3 inc.

	METALS, &c. (continued).		Latest Price.	Week's Dec. or Inc.
g	Copper Sheet	per ton	£81	£3 inc.
g	,, Rod	per ton	£81	£3 inc.
e	,, (Electrolytic) Bars ..	per ton	£70 10	30/- inc.
e	,, Sheets ..	per ton	£87	40/- inc.
e	,, Rod ..	per ton	£81	40/- inc.
e	,, H.C. Wire	per lb.	9¼d.	¼d. inc.
f	Ebonite Rod	per lb.	3/3	..
f	,, Sheet	per lb.	3/-	..
m	German Silver Wire	per lb.	1/6	..
h	Gutta-percha fine	per lb.	3/-	..
h	India-rubber, Para fine	per lb.	5/2 to 5/4	2d. inc.
i	Iron, Charcoal Sheets	per ton	£18	..
i	,, Pig (Cleveland warrants)	per ton	46/1½	10½d. dec.
i	,, Forgings, according to size	per ton	From £11	..
i	,, Scrap, heavy	per ton	47/6 to 50/-	..
i	,, Wire, galvanised No. 8 ..	per ton	£9 15	..
g	Lead, English Ingot	per ton	£13 5s. to £13 7 6	..
g	,, Sheet	per ton	£11 17s. 6d.	..
m	Manganin Wire No. 28	per lb.	3/-	..
g	Mercury	per bot.	£7 15	..
d	Mica (in original cases) small ..	per lb.	6d. to 1/	..
d	,, ,, ,, medium	per lb.	2/6 to 4/-	..
d	,, ,, ,, large ..	per lb.	4/6 to 8/6	..
p	Phosphor Bronze, plain castings	per lb.	1/- to 1/2½	..
p	,, rolled bars & rods	per lb.	1/- to 1/3	..
p	,, ,, strip & sheet	per lb.	From 1/1	..
o	Platinum	per oz.	81/6	1/6 inc.
e	Silicium Bronze Wire	per lb.	10d. to 11¼d.	½d. to 1d. in.
i	Steel, Magnet, acc'd'g to desc'p'n	per ton	£58	..
i	,, ,, in bars		£15 to £40	..
g	Tin, Block	per ton	£133 to £133 10	10s. inc.
g	,, Foil	per lb.	1/6	..
n	,, Wire, Nos. 1 to 16	per lb.	1/9	½d. inc.
p	White Anti-friction Metals—			
	"White Ant" brand ..	per ton	£42 to £62	..
j	Yarns, 2/10s Grey Cotton, on sp'ls	per lb.	8d.	..
j	,, 6 lea. Flax	per lb.	5½d.	..
j	,, 3 ply 10 lbs. Russian ..	per lb.	4½d.	..
j	,, 10 lbs. Russian, single ..	per lb.	4½d.	..
j	,, 180 lbs. Jute rove ..	per ton	£11	..
k	Zinc, Sh't (Vieille Montagne brd.)	per ton	£29 7 6	30/- inc.

Quotations supplied by Messrs.:—a G. Boor & Co.; b The British Aluminium Co., Ltd.; c Thos. Bolton & Sons., Ltd.; d F. Wiggins & Sons.; e Frederick Smith & Co., f India-Rubber, G.P. and Teleg. Works Co., Ltd.; g James & Shakspeare; h Edward Till & Co.; i Bolling & Lowe; j Walter H. Hindley and Co., Ltd.; k Morris Ashby, Ltd.; m W. T. Glover & Co., Ltd.; n P. Ormiston & Sons; o Johnson, Matthey & Co., Ltd.; p The Phosphor Bronze Co., Ltd.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

	Locality.	Week ending	Receipts for the week. £	£*	No. wks.	Total to date. £	£*	Miles open.	*
Tramways.	Aberdeen	Nov. 19	1,119	+ 79	25	37,465	+ 5,791	10	—
	Bath	,, 16	595	—	47	19,701	—	12½	—
	Birmingham ..	,, 19	5,262	+377	47	253,193	+13,960	52	—
	Blackburn	,, 11	826	+ 76	32	31,854	+ 3,173	13½	—
	Blackpool	,, 17	353	+ 60	34	41,821	+ 5,910	8½	—
	,, —Fleetw'd	,, 19	194	+ 8	20	20,254	+ 381	7½	—
	,, —Lytham	,, 17	155	— 14	2	353	— 114	7½	+ ½
	Bolton	,, 20	1,683	+ 45	33	63,472	+ 478	25	—
	Bournemouth ..	,, 16	873	+ 15	33	38,310	—	10½	—
	Bradford	,, 12	3,864	+248	31	151,583	+35,939	54	—
	Brighton	,, 20	795	+ 44	—	35,828	—	9	—
	Bristol	,, 18	4,631	+328	—	—	—	28	—
	Devonport ..	,, 11	475	— 33	45	24,225	+ 3,282	6	—
	Dudley—Sto'rb'ge	,, 11	775	— 7	45	39,100	+ 1,419	16½	—
	Gateshead ..	,, 11	924	+ 28	45	41,115	+ 1,372	10½	+ ½
	Gr'n'k—Pt. Glasgw	,, 11	580	+ 30	45	26,265	+ 1,023	7½	—
	Oldham—Ashton	,, 11	521	— 11	45	24,879	— 1,028	5	—
	Potteries	,, 11	1,829	+171	45	77,535	+ 5,709	28½	—
	South Staffs. ..	,, 11	821	—170	45	34,854	— 6,601	21½	— ½
	Swansea	,, 11	467	— 40	45	24,631	+ 972	5½	—
	Wolverhampton ..	,, 11	375	+ 4	45	17,712	— 70	10½	+8
	Yorks. Wool Dist.	,, 11	521	+134	45	26,610	+ 8,894	6	—
	Miscellaneous ..	,, 11	2,920	—	45	163,955	—	—	—
	Burnley	,, 19	1,015	+264	—	—	—	10½	+2½
	Burton-on-Trent ..	,, 13	316	— 14	—	11,734	—	8½	—
	Cardiff	,, 12	1,902	+ 37	32	67,560	+ 1,664	14	—
	Chatham & District	,, 17	496	— 7	46	27,223	+ 2,199	8·63	—
	Cork	,, 17	429	+ 38	46	21,746	— 2,514	9·89	—
	Dover	,, 19	164	+ 6	46	10,180	— 255	8	—
Light Rly.	Dublin	Nov. 18	4,548	+364	—	104,920	— 2,793	47	—
	East Ham	,, 19	661	— 27	33	24,727	+ 1,458	6⅔	—
	Glasgow	,, 19	14,471	+1078	45	359,331	+22,169	72½	+6½
	Halifax (2 weeks) ..	,, 16	2,625	+273	33	50,897	+ 3,872	34½	+2½
	Huddersfield ..	,, 19	1,182	+ 78	33	46,296	+ 2,9·6	25	—
	Hull	,, 19	2,039	+204	33	73,458	+ 9,615	13	+2
	Ilkeston	,, 16	106	— 18	33	4,836	—	8·5	—
	Ipswich	,, 19	328	—	33	17,066	—	10½	—
	Isle of Thanet ..	,, 19	271	+ 8	46	31,436	+ 1,650	10½	—
	Leeds	,, 12	5,402	+296	92	194,678	+11,721	69½	+8½
	Liverpool	,, 12	10,342	+ 179	46	477,830	+13,420	103	—
	London C. C. ..	,, 5	12,902	+2892	52	404,744	+86,152	47½	+7½
	Manchester	,, 19	11,679	+886	33	411,871	+18,101	137½	+12½
	Newcastle	,, 19	3,528	+ 77	—	—	—	17	—
	Portsmouth	,, 19	1,462	+143	—	69,171	+ 5,675	14½	—
	Salford	,, 14	3,966	+153	32	135,087	+ 8,148	30	—
	Sheffield	,, 20	4,433	+197	34	160,567	+ 3,239	34½	+1½
	Southampton ..	,, 17	886	+ 33	33	33,697	— 2,128	10½	—
	Southend-on-Sea ..	,, 16	239	+ 26	33	13,161	+ 1,357	6½	—
	Sunderland	,, 6	1,117	+ 23	31	41,266	+ 720	21	+1
	Tyneside	,, 16	345	+ 57	46	18,070	+ 3,037	8·9	+·4
	West Ham	,, 17	1,007	—	38	35,826	—	9·78	—
	Wolverhampton ..	,, 16	708	+287	—	—	—	9·5	—
Elec. Rly.	Cen. London Rly. ..	,, 19	7,057	— 81	20	124,918	— 353	6	—
	City & S. Lon. Rly.	,, 20	2,963	— 67	21	52,775	— 1,914	6½	—
	Dublin—Lucan Rly.	,, 18	96	— 5	20	2,657	— 52	6½	—
	G. N. and City Ry.	,, 19	1,305	—	40	40,408	—	3½	—
	L'pool Overh'd Rly.	,, 20	1,415	—147	21	33,427	— 1,759	6½	+4½
	Mersey Railway ..	,, 19	1,561	+194	20	29,333	+ 2,447	4½	—

* Compared with the corresponding period of 1903.

SIX YEARS OF BRITISH AND AMERICAN ELECTRICAL EXPORT STATISTICS.

By W. POLLARD DIGBY, F.S.S.

It was the greatest of the apostles of Free Trade, Richard Cobden, himself, who once naïvely remarked that "every man was apt to be Protectionist at heart—so far as his own industry was concerned." In the fiscal controversy, which is still being carried on with undiminished ardour, the great majority of the electors in the United Kingdom are apt to be swayed, not by the broad principles of economic laws, nor by a general review of the whole situation, but by the purely sectional needs of their own industries. Sooner or later the Tariff Commission (the offshoot of the Tariff Reform League—the frank omission of the adjective is, perhaps, suggestive) will do for the electrical trades what it has done for the iron trades, namely, issue a volume of anonymous evidence containing some juggled percentage statistics. That is, of course, if the Commission continues to exist, and if the representative of the "ruined electrical industry" and his friends are sufficiently insistent in their demands.

Pending the publication of such a report, the writer proposes to enumerate the exports of the United Kingdom and the United States, to certain trade zones, with a consideration of the tendencies therein exhibited. He also proposes in a later issue to give the figures of the British import trade, and to show its relation to certain of the figures of the expansion of the internal electrical trade of Great Britain.

In view of the great insistence which is placed—and placed erroneously by a large number of students of economic statistics—on export trade figures, we will first deal with these. A division of the world's markets into trade zones, is, perhaps, the best procedure. The familiar statistical returns issued by the Board of Trade give the broad classification of "British Colonies and Other Possessions," and "Foreign Countries," sub-dividing these latter with a minuteness which is, at times, tedious. For the purpose of this review of the subject, the writer proposes to classify American and British exports into the British Colonies and other Possessions among the following trade zones:—(1) British North America, (2) British East Indies, (3) British Africa, (4) British Australasia, (5) other British Possessions. The foreign trade is divided into a lesser number of groups, namely, (1) Europe (excluding Great Britain and Ireland, but including the Azores, Madeira, and the Canary Islands), (2) South America, (3) other foreign countries. So far as American exports are concerned, the United Kingdom is treated as a separate market, and *vice versâ*.

The comparison of the exports and imports of different articles in different countries is a matter of extreme difficulty, by reason of the fact that the articles are classed differently in various countries. The United Kingdom exports "Electric Lighting Apparatus," "Electrical Goods and Apparatus," "Electrical Machinery," "Telegraphic Cables and Apparatus," and imports "Electrical Goods and Apparatus," "Electrical Machinery," and "Telegraph Cables and Apparatus." The United States exports "Electrical Machinery" and "Electric Apparatus," while no imports of an electrical nature seem to be separately chronicled. Starting, therefore, with the exports from Great Britain and Ireland of "Electrical Lighting Apparatus," we have a classification which was regrouped in the 1903 financial year; up to the end of 1902 "Electric Lighting Apparatus, or parts thereof (except steam engines)" apparently embraced all classes of electrical exports. The re-grouping provided "Electrical Goods and Apparatus (except Machinery and Telegraphic Appliances)" and "Electrical Machinery of all kinds."

During the six years under consideration, it will be noticed from the foregoing tables that (1) the total exports to "Foreign Countries" fell steadily until 1901, then recovered slightly; (2) that the chief fall was in exports to European countries, the recovery beginning in 1902; (3) that in the Board of Trade returns the trade to the United States is not regarded of sufficient importance for separate computation since 1898; and (4) that the trade to "Other Foreign Countries" shows a healthy increase.

TABLE I.—(A)

Year.	European countries.	South American countries.	United States.	Other foreign countries.	Total to foreign countries.	Gross total to all parts.
1898	£201,851	£49,174	£2,272	£38,734	£266,803	£514,632
1899	134,524	52,278	—	47,585	241,819	510,753
1900	108,671	46,078	—	59,276	212,098	546,155
1901	63,422	34,770	—	70,298	180,271	552,777
1902	39,065	28,069	—	119,672	194,576	617,532
1903	65,825*	53,314*	—	97,954*	217,093*	678,184*
	11,234†	51,452†	—	99,188†	161,874†	437,196†

(B)

Year.	British North America.	British East Indies.	British Africa.	British Australasia.	Other British possessions	Total to British possessions
1898	£1,109	£56,476	£112,879	£69,712	£14,495	£247,829
1899	1,597	61,387	100,087	86,816	19,052	266,939
1900	3,167	72,139	78,440	146,320	24,011	324,057
1901	2,338	93,201	120,160	153,087	18,710	372,506
1902	1,734	114,094	162,506	122,930	18,692	422,956
1903	3,948*	105,408	215,411	117,000	29,424	461,091
	9,294†	108,739	73,579	57,895	25,805	275,312

* Electrical goods and apparatus.
† Electrical machinery of all kinds, previously included "Machinery not steam engines."

The total volume of the trade to British Colonies and possessions shows a steady and continuous increase. Considering the different trade zones in this section, it is apparent (1) that the trade to British North America is almost infinitesimal; (2) that the exports to the British East Indies are of a very healthy character; (3) that, thanks to the cessation of the war, there was a boom in the exports to British Africa; and (4) that the trade to British Australasia has not been well maintained since 1901. The trade to Colonies and Possessions not separately enumerated does not call for comment.

The other export from the British Isles of prime importance to electrical engineers is that of telegraphic cables and apparatus.

TABLE II. (A).—*Electrical Exports (Telegraphic) of British Manufacture according to Trade Zones.*

Year.	European countries.	South American countries.	United States.	Other foreign countries.	Total to foreign countries.	Gross total to all parts.
	£	£	£	£	£	£
1898	131,363	55,026	15,585	97,515	299,489	985,233
1899	93,154	43,522	50,057	—	537,045	1,406,734
1900	608,105	605,009	519,175	—	2,282,459	2,801,401
1901	763,639	64,098	35,048	—	1,068,759	3,147,895
1902	59,247	131,358	388,222	—	1,028,751	2,838,641
1903	75,412	109,403	74,254	—	1,342,183	1,808,465

(B.)

Year.	British North America.	British East Indies.	British Africa.	British Australasia.	Other British Possessions.	Total to British Possessions
	£	£	£	£	£	£
1898	97,725	209,649	107,009	88,000	183,911	685,794
1899	90,425	86,707	555,989	81,916	24,652	849,689
1900	250,420	115,898	46,679	91,411	15,534	519,942
1901	85,674	144,228	1,379,731	417,651	51,842	2,079,226
1902	832,735	79,345	230,373	633,795	33,642	1,809,890
1903	6,572	174,522	129,037	130,304	25,847	466,282

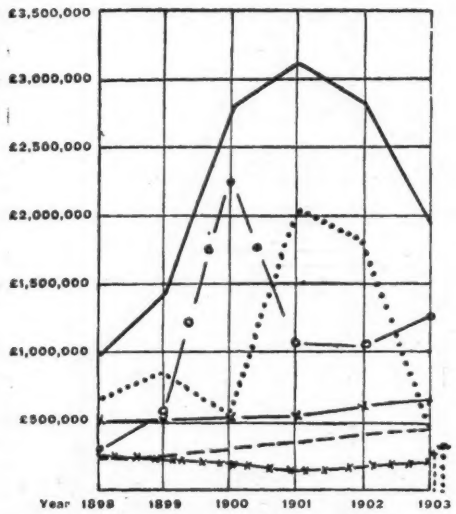
The preceding tables show a trade which, even grouped among certain trade zones, is of so wildly fluctuating a character that its delineation in the form of a curve representing the trade in each trade zone would be futile. Taking in this case merely the two broad groupings of exports to "foreign countries," and to "Colonial and other British possessions," it may be of passing interest to note the yearly variations. In 1898 the Colonial market was over double the volume of the foreign, and about 55 per cent. greater than the foreign trade in 1899. In 1900, however, the foreign trade was nearly four times that of the Colonial. In

1901 the Colonial trade was twice as much, and in 1902 was 78 per cent. greater than the foreign trade. The positions were again reversed in 1903, when the foreign trade was three times greater than the Colonial. The best computation is, perhaps, that of adding the aggregate trade to each of these broad divisions for both the telegraphic and non-telegraphic exports.

Period, Six Years Ending 1903.

Value of British electrical exports, non-telegraphic, to foreign countries	£1,484,534
Value of British electrical exports, non-telegraphic, to British possessions	£2,370,690
Value of British electrical exports, telegraphic, to foreign countries	£6,568 686
Value of British electrical exports, telegraphic, to British possessions	£2,910,823

If electrical engineering manufacturers are to consider the fiscal questions connected with preferential tariffs with the Colonies from the purely sectional view of their own works output, ignoring all questions of food prices, even then the evidence is not unanimous. The dynamo, arc lamp, switch, motor and fittings manufacturers, judging on the evidence of the exports of their own articles, will see a Colonial market 60 per cent. greater than that to foreign



Electrical Exports from the United Kingdom.

Electric lighting apparatus (1898 to 1903 inclusive), and Electrical goods and apparatus in 1903 :
To British Colonial and other possessions .. ------
To other Foreign Countries .. —X—X— To all destinations .. ——X——
Telegraph cables and apparatus :
To British Colonial and other Po-sessions .. ..
To other Foreign Countries .. ——o—— To all destinations .. ———
Exports of electrical machinery in 1903 only :
To British Possessions .. .. T To Foreign Countries .. X

Curve I.

countries, and might be expected to look with favour on a sort of Zollverein. On the other hand, the exporters of telegraph cables and instruments who, in the last six years have sent to foreign countries exports, of more than twice the value of the exports sent to the Colonies, would not be inclined to place so great a value on a system of Colonial preferences which would involve food taxes and a jeopardising of their greater foreign markets.

The yearly fluctuations in the British electrical exports are shown diagrammatically in fig. 1. It may be contrasted with fig. 2, which gives the entire exports of electrical machinery from the United States to two main directions, namely, to the United Kingdom and to British Possessions, as well as the total trade.

Table III. gives in further detail the distribution from the United States to the various trade zones. It will be noticed that the United Kingdom takes nearly one-half and the British North American nearly one-fourth of the exports in 1903.

Figs. 3 and 4 respectively contrast the British and American exports which are nearest alike to the different trade zones. Of fig. 3 it may be noted that both Great Britain and the States are ceasing to supply the various European countries with electric lighting apparatus or elec-

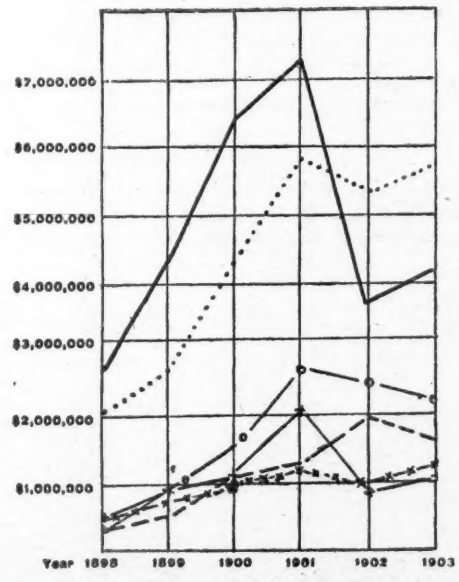
TABLE III.—*United States, America, Electrical Exports, Electrical Machinery.*

In dollars.

Year.	United Kingdom.	Rest of Europe.	British North America.	British East Indies.	British Africa.	British Australasia.
1898	380,354	756,825	178,160	19 864	40,459	83,971
1899	864,678	799,587	262,083	13,929	139,855	58,374
1900	1,568,653	553,235	790,313	29,050	46,163	187,459
1901	2,760,733	501,825	807,419	317,081	18,395	169 539
1902	2,573,495	255,659	1,147,612	208,039	68,594	563,272
1903	2,256,062	324,019	1,240,900	25 622	122,434	200,469

Year.	Other British Possessions.	Other Foreign Possessions.	South America.	Total to British Colonies and Possessions.	Entire exports of electrical machinery.
1898	3,011	420,294	69,645	325,446	2,052,564
1899	55,387	499,478	42,739	529,628	2,736,110
1900	96,344	1,004,432	65,343	1,149,329	4 340,992
1901	39,772	1,111,111	82,640	1,352,406	5,812,715
1902	11,675	538,264	13,126	1,993,212	5,379,746
1903	71,428	1,456,454	81,971	1,660 953	5,779,459

trical machinery. Despite a greater distance to be traversed, Great Britain has always sent, and still sends, a greater value to the numerous South American Republics than does the United States. The curves for "Other Foreign Countries" show that the British manufacturer has sought and secured other markets, but also show that the American manufacturer has, in the countries not embraced in the



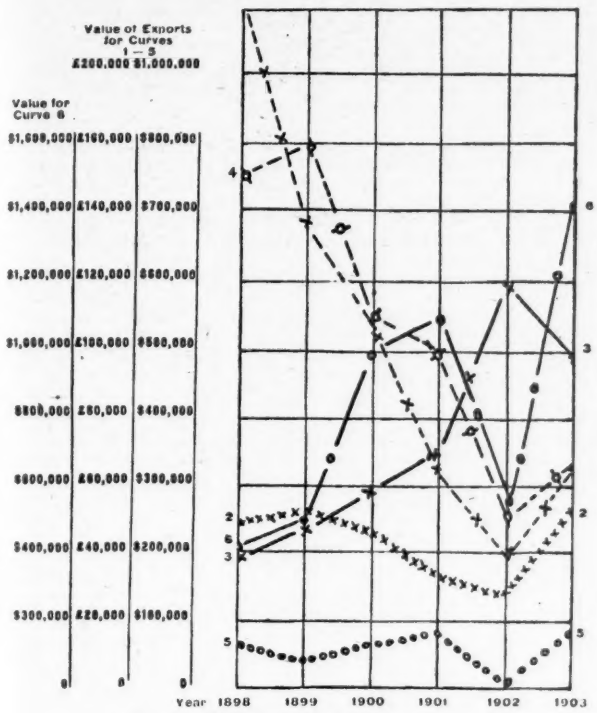
Electrical Exports from the United States.

Electrical machinery :
To all destinations .. .. To the United Kingdom .. ——o——
To British Possessions .. .. ------
Instruments and apparatus for scientific purposes :
To all destinations .. ——— To the United Kingdom .. ——x——
To British Possessions .. .. —x—x—

Curve II.

geographical trade zones of our catalogue, a trade larger than that of his British rival. Fig. 4 shows the distribution among the four chief Colonial groups. In regard to British North America, one has here a trade belonging absolutely to the United States. In the British East Indies the English trader has been supreme; the American trade was negligible prior to 1901 (the year of the erection of a large power plant in Southern India). There was a decrease to 1902, and a further one for 1903. The trade to British Africa is very largely British. In the recovery of the

market subsequent to the war, it seems that the lion has an appropriate share of the trade. The Australasian trade is less satisfactory. British exports have fallen since 1901, and 1902 proved for the American exporter a year in which he nearly equalled his rival.



Electrical Exports to Foreign Countries.

British exports of electric lighting apparatus and electrical goods and Apparatus:

To European Countries .. X- - -X- - To South American Countries .. xxxxx
To other Foreign Countries .. .. —X—

American exports of electrical machinery:

To European Countries .. - - - ⊙ - - - To South American Countries ooooo
To other Foreign Countries (excluding Great Britain) .. .. —O—

Curve III.

TABLE IV.—United States Electrical Exports.

Instruments and Apparatus for Scientific Purposes, including Telegraph, Telephone and other Electric.

Value in dollars.

Year.	United Kingdom.	Rest of Europe.	British North America.	British Africa.	British Australasia.	British East Indies.
1898	538,293	648,876	305,016	90,333	57,907	33,032
1899	950,426	1,110,994	429,734	55,986	177,524	54,762
1900	1,145,764	2,246,716	281,162	93,447	535,057	86,777
1901	2,105,611	1,735,152	205,829	262,661	463,701	406,639
1902	825,755	416,039	451,477	131,665	432,960	62,814
1903	1,070,158	394,592	466,921	309,412	92,913	49,885

Year.	Other British possessions.	Other foreign countries.	South America.	Total to British Colonies and possessions.	Gross total to whole of the world.
1898	45,091	734,446	317,809	531,379	2,770,803†
1899	73,836	1,064,904	470,914	791,842	4,399,180†
1900	65,675	1,329,678	652,490	1,062,118	6,435,766†
1901	37,222	1,372,838	771,578	1,376,052	7,361,231†
1902	70,182	933,308	391,470	1,065,187	3,631,759*
1903	93,928	913,289	479,414	1,349,306	4,206,759*

* Includes only telegraph, telephone and electrical appliances. The gross total of other apparatus was $1,757,717 in 1902, and $2,923,891 in 1903.
† Includes scientific apparatus of all sorts.

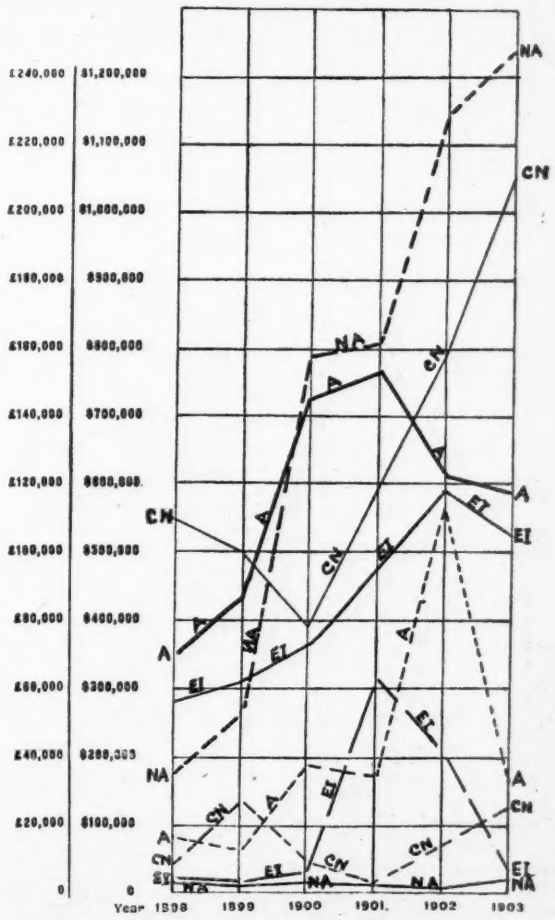
There is yet another American export which is of interest to the British manufacturer, namely, that of "Instruments and Apparatus for Scientific Purposes, including telegraph, telephone, and other electric." Among the many classifications of British exports there are none that can be directly contrasted in the same manner as that with which the British exports of "Electric Lighting Apparatus" and the American exports of "Electrical Machinery" have been compared. Table IV., which is given below, is partially illustrated in fig. 2.

One comparison may be made in regard to the British exports, and that is the relation which they have borne to the aggregate capital (ordinary, preferential, and debenture) of the manufacturing electrical undertakings.

TABLE V.

Year.	Aggregate capital at end of year.	Net increase for year.	Gross total electrical exports.	Gross electrical exports per £100 aggregate capital.
1898	£10 535,937	£2,016,507	£1,472,915	£13·98
1899	16,799,152	6,263,225	1,917,492	11·41
1900	21,708,180	4,909,028	3,347,556	15 42
1901	25,990 6'6	4,282,426	3,700,672	14·23
1902	29,852,575	3,861,969	3,456,173	11·57
1903	35,768,000	5,915,425	2,923,845	7 93

The foregoing table, studied in conjunction with fig. 5, clearly shows that the great increase in capital which has taken place during the last six years has not been occasioned



Exports to British Colonial and other Possessions.

Exports from the United States of electrical machinery:

To British North America .. NA To British East Indies .. EI
To British Africa .. .. CN To British Australasia .. A

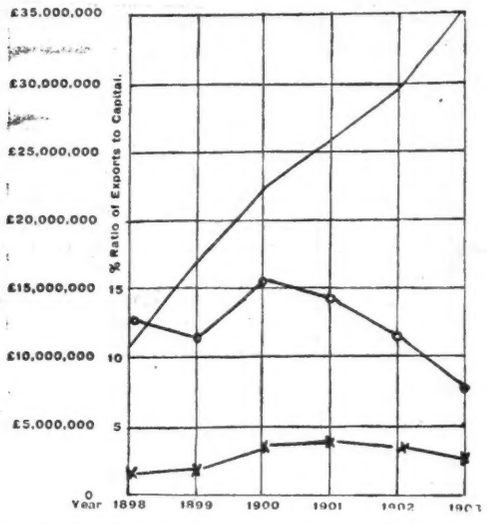
Exports from the United Kingdom of electric lighting apparatus and electrical goods and apparatus:

To British North America .. NA To British East Indies .. EI
To British Africa .. .. .. CN To British Australasia .. A

Curve IV.

by reason of a growing export trade. When it is remembered that each of these exports has occasioned the purchase of raw material and labour, and includes profit, and carriage to the port of shipments, it becomes at once apparent that the profit from the export trade, important though it be to some sections of the electrical industry, is at present of little importance to electrical manufacturers as a whole.

It is certainly capable of improvement. But if British manufacturers had sent the $1,660,953 worth of electrical machinery and $1,349,306 worth of scientific apparatus exported from the United States in 1903 to British colonies



Relation between Capital Invested in Electrical Manufacturing Undertakings and Electrical Exports from the United Kingdom.

Aggregate capital .. .. ——— Exports.. .. .. —x—
Ratio of exports to capital .. .. —o—

Curve V.

and possessions, the combined value only would have served to raise the aggregate exports by £602,052. Expressed in its ratio per £100 of manufacturer's capital, it would amount to 1·67 per cent., or 33s.

The matter of electrical imports will be treated in a later issue, and their proportion to capital invested, and the various indices of electrical activity shown.

LATEST IMPROVEMENTS IN CARBON-MAKING.

By EUGENE ORNSTEIN.

After a lecture of Prof. T. Zellner.

The object of this article is to describe the various improvements which have recently been made in the industry of artificial carbons. The steadily increasing use of carbons in the electrical industry explains the fact that the number of firms making them grows from year to year. There are about 30 carbon factories in Europe between which competition is to the benefit of the general public, but to their own disadvantage.

The Americans—more practical than their European *confrères*—have united all their 30 factories into an important trust; in consequence of this combination they can easily dictate prices, especially as they are protected by high duties. A few figures are sufficient to show the importance of the carbon industry; about 10,000 persons are employed, and a capital of at least five million pounds is invested in it. The annual turnover of this industry amounts at least to this figure.

We will first of all consider the manufacture of electrodes for electro-chemical works. The crisis from which the carbide industry has suffered during the last few years has obliged the carbide factories to exercise the utmost economy. As one of their largest expenses is due to the consumption of the carbon electrodes, they naturally did their best to obtain these as cheaply as possible. That they have succeeded in this, is shown by the fact that in five years the price has been lowered by 50 per cent.

The factories for the production of electrodes have been obliged, owing to its cost, to abandon the use of retort carbon, and to learn the treatment of anthracite, this raw material being considerably cheaper than retort carbon. The final product has not, however, suffered at all by this change.

The best proof of this is that the anthracite electrodes—as produced to-day by first-class manufacturers—have a longer life than those made three years ago from retort carbon. Whereas at the beginning of the carbide industry, 10—15 kg. of electrodes were necessary in order to obtain 100 kg. of carbide, this has now been reduced to 6—10 kg., and several factories are said to use even much less than this (3 kg.).

The impurities in anthracite (which contains at least 3—5 per cent. of ash) prevent its employment in the manufacture of aluminium; the electrodes which are used in this industry are made from petroleum-coke, which can be obtained with only 0·1 per cent of residue.

Wood charcoal cannot yet be employed for this manufacture; electrodes made from this material, which is both cheap and free from ash, have a very much higher electric resistance than those made from other varieties of carbon. They consequently consume too much power, which puts them out of court.

In 1891, W. Luzi began to publish his researches which were destined to reveal the nature of carbon (Berichte Ch. G., 1891, p. 4085; 1892, p. 1378; 1893, p. 890).

He showed that it was possible by the action of heat, to convert amorphous carbon in the midst of silicates having no chemical influence on the carbon, into crystals of graphite.

He obtained a deposit of carbon with a metallic silvery white appearance by exposing a surface of porcelain, at a temperature of 1,700—1,800° C., to a smoky flame. He came to the conclusion that there were reasons to expect the discovery of a large number of modifications of carbon, and that it would be possible to effect the transformation of these different varieties into one another.

Since this time the study of the change of amorphous carbon into crystalline graphite has progressed considerably, thanks chiefly to the help of electricity. In 1893 Girard and Street patented (D.R.P. 78,926) the transformation of amorphous carbon into graphite, by means of the voltaic arc. The "Le Carbone" Co. utilises this process in its factories in Savoy and Germany. This company chiefly produces dynamo brushes which are characterised by their homogeneity and their specific resistance, which is considerably lower than that of ordinary carbons, and which enables them to be used with a current density of 15—20 amperes per sq cm. of bearing surface; in addition, the friction is very small, and consequently the wear of the commutator is slight These qualities justify their very extensive use in spite of their high price. For tramcars, where this expense is particularly important, the use of brushes of amorphous carbon is more economical.

The American Patent No. 568,323 (September 29th, 1896) granted to Acheson, marks a very important advance in the manufacture of electro-chemical products. Acheson's claim seems to start from the fact that carbon is transformed into graphite, by heating it in the presence of substances which form carbides, the decomposition of which furnishes graphite.

Two years before the date of Acheson's patent, Prof. Borchers, in Aachen, also published in the *Electrochemische Zeitschrift* the idea of this conversion by the addition of materials capable of forming carbides. We need not refer to the contest between Acheson and Borchers, which is well known to all.

Acheson heats the articles, which are formed from amorphous graphite mixed with a little oxide of iron, &c., in an electric furnace with a very large electric current; the articles are moulded to their final shape before the graphitisation.

The International Acheson Graphite Co., which utilises power from the Niagara Falls, produces an important amount of artificial graphite and of graphitised electrodes.

These electrodes are characterised by their conductivity, which is four times as great as that of those made of amorphous carbon, by the ease with which they can be worked—they can be cut with a knife—and, above all, by their incomparably higher resistance to the action of chemicals. This explains their continuously increasing use in electrolysis.

Their very high price altogether excludes them from use in the manufacture of calcium carbide, and, moreover, the Acheson Co. does not manufacture electrodes of large size.

According to the reports of the United States Geological Office, the Acheson Co. produced—

In 1897	81,000	kilos
In 1900	430,000	„
and in 1901	1,200,000	„

of artificial graphite and graphitised articles; the production has increased appreciably since 1901. (See E. Deuath, "Le Graphite." Leipsig. 1904.)

We have no knowledge of progress in the manufacture of carbons for battery services. It must be remembered that the consumers are asking more and more for unbaked carbon agglomerates. A large part of the oxygen of the manganese dioxide is, in fact, driven off in the furnace. We have found that the quantity of carbon, in the carbons employed for this purpose, is without effect on the voltage of the batteries. Natural graphites from Bohemia, containing 60—70 per cent. C., give the same results as those from Ceylon with 85—90 per cent. C. The life of the agglomerates depends on the percentage of $Mn O_2$ in the oxide used. This branch of our industry gains but little ground. The modern telephone exchanges are abandoning the use of batteries, and even in small towns, electricity can be obtained by doctors in a more convenient manner (see Prof. Zellner, *Centralblatt Accumulatorenkunde*, 1903, pp. 87, 88; C. F. Burgess, *Electrical World*, 1902, p. 156).

Carbon Brushes.—The relative advantages and disadvantages of copper and carbon brushes have often been the subject of study by electricians. Latterly the attempt has been made to make brushes of a combination of these two materials

Dr. Seiffert surrounds a metallic network of copper with carbon. M. P. Germain does the same. M. Loewenthal coats carbon particles with copper (electrolytically or otherwise), and compresses these strongly, so that the grains form a compact mass without the use of any binding material, according to his claims.

Ringsdorff, at Essen, compresses a mixture of powdered copper carbon (graphite) and tar at a pressure of 500 kilos, in moulds which are completely closed, and then bakes them at a very high temperature. One such brush, which gave satisfactory results in practical work, was composed of 67 per cent of Cu and 33 per cent. of C (see Dr. Streintz, Leitvermögen von gepressten Padern, "Conductivity of Compressed Powders," Dr. Ing. Max Kahn, Uebergangswiderstand von Kohlenbürsten.

Flame Carbons.—Casselmann was the first to study the effect of different salts on the voltaic arc. In 1843 (Poggendorf's Annalen) he had already compar d the intensity of the light obtained from ordinary carbons, and from carbons saturated with solutions of the salts of barium, strontium, &c. He came to the conclusion that with the same amount of power, twice as much light was obtained by the use of these salts.

Carré (*Comptes Rendus*, 1877, p. 346) advises the incorporation with the carbons intended for use in arcs, of metals in the form of salts, or oxides, to vary the intensity and the colour of the light. He states that the arc, with carbons prepared thus, has twice the usual length, and that the candle-power is increased in the ratio of 1—1·5.

Niewerth, at Berlin, patented in 1894 carbons which were provided with two or more channels filled with substances to steady the light, or to increase its intensity, or to colour the light.

In spite of these discoveries, the incorporation of mineral bodies with the carbons has been avoided, because it tends to upset the steadiness of the arc, which was only obtained after much trouble by means of the core (a mixture of carbon and potassium silicate), which was first proposed by Jablochkoff, patented to Casselmann, and used industrially for the first time by Siemens Bros., Charlottenburg, 1879.

It is evident that every percentage of material other than carbon reduces in proportion the time during which the electrodes burn, which is always a disadvantage. In addition, it is extremely difficult to obtain an absolutely homogeneous mixture of much carbon and little salts, even by using the most perfect mixing machines and greatly prolonging the time of mixing—and this results in an unsteady light of variable colour. Saturating the carbons with solutions of salts gave the same negative result, and dipping them into the fused salts was equally unsatisfactory. Homogeneity, which is absolutely indispensable, was never obtained. Also there was no want of another colour, as one was very well satisfied to have side by side the yellow light of the incandescent lamps, and the white light of the arcs.

At the last Paris Exhibition the 50,000 candles of the Bremer arcs on the Eiffel Tower attracted universal attention. The general public saw for the first time an arc lamp giving a light, golden-yellow in colour, of an unusual brilliancy and intensity. This date marks the beginning of illumination by means of "flame" arcs.

The most important of the very large number of patents taken out by Bremer and his company are B.S.G.D.G. 259,571, D.R.P. 66,094, 69,271, 75,520, &c., the whole forming an important series. The fundamental idea of the invention lies in the incorporation with the carbons of at least 4 per cent. of fluor in form of the different fluor salts. Prof. Wedding, of the Berlin Technical School, published in the *Elektrotechnische Zeitschrift* for July, 1900 and 1902, p. 702, the results which he had obtained with these electrodes.

He showed that the Bremer lamp, with continuous current gave with Bremer carbons three times as much light as ordinary lamps and ordinary carbons. His result with alternating currents was not so good; nevertheless, he obtained with Bremer lamps and Bremer carbons double the light hitherto obtained with ordinary lamps and carbons for the same amount of power.

But this undeniably great advantage was accompanied by several drawbacks. The light was unsteady; only carbons of small diameter could be used, and, in consequence, they quickly burnt away. By the decomposition of the air, nitrous bodies were formed which destroyed the metallic parts of the earliest lamps, and the scoria formed prevented the regular action of the lamp, which often altogether refused to work.

With quite remarkable energy, the Bremer Co. has done its best to remedy all these defects; it has, at any rate, partly succeeded. In any case, both industry and science owe it much for the recognition of the indications given. The popularity of this new coloured light of great intensity on the one hand, and the disadvantages detailed above on the other, have given an impetus to a series of researches. The results obtained with the Bremer carbons have been achieved, whilst at the same time the greater number of the disadvantages mentioned have been avoided.

J. F. Sanders (U. St. P. 649,551) incorporates with the carbons, oxides, or phosphates of Cu or Mg, and makes the cores of carbon and soluble alkaline phosphate. He coats the carbons thus prepared with a double coating of magnesium. This process has not been taken up in practice.

The patents of MacMaruss U.S.P. 504,815 (carbon with iron, core with lime), of Roberts, U.S.P. 562,030 (core of carbon and potassium chromate) have had no success at all.

The process of E. Sander (D.R.P. 137,576) is of more importance. He fuses the oxides of the alkaline earths, or of the rare earths (MgO, Mn_2O_3, ThO_2, ZrO_2) with the oxides or salts of the iron group, either in the electric furnace, or in other furnaces capable of giving a temperature high enough for the fusion of these oxides. The products of this fusion are incorporated in the carbons, and used in the cores. Electrodes thus made, give a fine flame of a golden yellow colour; the scoria slag which are formed constitute a serious obstacle to their general use.

A. Edelmann, Charlottenburg, recommends the incorporation of boron-sodium-calc (the mineral tica) and of soda lime with the carbons, which exercises a favourable influence on the formation of scoria. We do not know that the commercial manufacture of these carbons has attained to any importance.

The carbon factory at Liège has acquired Hopfeld's patents Hopfeld recommends the incorporation of carbides. The hygroscopic nature and the quantity of impurity, due to the industrial carbide, characterise these electrodes. Also they must be coppered, which is a very great disadvantage.

It is obvious that all these patents have one common starting point, namely, the addition of a body with a very high boiling point, so that no vapour is disengaged or flame formed but at the temperature of the arc itself.

The establishment of this fact is enough to determine the number of bodies to choose from, and of possible patents.

To manufacturers of electric light carbons, it was evident that the effect of the Bremer carbons might be obtained by simply adding to the core, the ingredients incorporated by that invention in the carbons themselves. The laboratories of the carbon factories studied this question about 1900, and a short time after they were all ready, practically at the same time, to sell "flame" carbons by which the same candle-power and the same colours, &c., could be obtained for the same amount of energy as is required by the Bremer process. As much less salt is employed, the light is more stable, the time of burning is longer, and the carbons are less expensive.

The cores of the ordinary carbons in use at the present time contain:—

10—15 per cent. of potassium silicate;
90—85 per cent. of carbon (either soot or broken-up electrodes, or a combination of these two).

For carbons for "flame" arcs, a part (about one-half) of the carbon of the core only is replaced by fluorides or the oxides of the rare earths.

The analysis of these cores is as follows:—

—	Yellow light.	Grey-white light.	Whitish-blue light.
Carbon	44—50 %	44 %	48 %
Potassium silicate...	8·6—6·4 %	7·1 %	9·4 %
Salts	CaF_2 46·5—42·8	BaF_2 47 %	Ca_2O_3 42·1 %
Impurities	0·9—0·8 %	0·8 %	—

The construction of the flame arc lamps has been modified in many ways; the electrodes are fixed horizontally or inclined to one another at an angle of 5—50°. The old idea of Jehl-Hardtmuth, of using reflectors to retain the heat and prolong the life of the carbons has been adopted again.

The section of the carbons has been varied, every possible form having been studied, and sometimes patented.

The number and position of the channels for the core has been varied. Practice has shown that the form which has been in use generally, is the best.

These researches have not produced any improvements.

The laboratories of Schiff & Co., have attained the following results regarding the colouration of the arc by different salts:—

(*a*) Colouration of the flame of the arc by the following elements added as powders:—

Mg: red violet, unsteady light, changing colour;
Al: dull green, without brilliancy;
Zn: white;
Cu: dull blue;
Fe: violet tending to red;
Si: violet tending to red.

The arc was a little smaller than that with ordinary carbons.

(*b*) The oxides generally give the same colour as the elements:—

BaO: bluish
SrO: rose;
CaO: red;
FeO: violet;
MnO: greenish;
La_2O_3: pure white;
Di_2O_3: pure violet;
Ti_2O_3: blue-violet;
ThO_2: reddish;
Ce_2O_3: white-blue.

It is noteworthy that the suboxides give a more intense colour than the oxides: FeO gives a richer violet than Fe_2O_3 and MnO a richer green than MnO_2.

The arc with all these oxides but little surpasses the ordinary arc. Cerium oxide alone, gives a large flame like the Bremer carbons.

(*c*) The chlorides, bromides, iodides, nitrates, citrates, &c., almost always give the same colour as the fluorides which alone have attained an industrial application on a large scale. The other salts decompose the potassium silicate. Many attempts have been made to use concentrated solutions of sugar, or of magnesium oxychloride, or even of zinc chloride, as a binding material, but always with negative results.

Fluorides which are insoluble in water, are without action on potassium silicate. At the same time it is necessary to be sure that the materials used contain neither traces of free fluoride nor hydrofluoric acid.

The colours obtained with the fluorides are:—

NaF: dull yellow without brilliancy, small flame;
KF: violet, otherwise like NaF;

LiF: rose, less powerful than SrF_2;
CeF_4: a white-tinted blue, very brilliant, colour and appearance exactly similar to that of CeO_2;
CaF_2: yellow, the light is in every respect the same in effect as with Bremer carbons. The precise shade depends on the purity of the CaF_2.
BaF_2: dirty white, from time to time bluish, difficulty to obtain a steady flame.
SrF_2: rose;
CuF_2: violet, no brillancy;
CdF_2: yellowish, dull;
SbF_3: yellow, dull;
FiF_3: clear yellow, dull;
UF_6: white, no intensity;
M_2F_6: white, dull green;
TiF_4: greyish yellow, dull.

A white light cannot be obtained by combining with the core two or more salts, the mixtures do not give the complementary colours; sometimes the colour of one component is seen, sometimes that of the other. On account of this the patents taken out to cover the idea of the complementary colours have not been practically applied.

As yet no one has succeeded in preparing a core to give a "flame" arc of a pure white, and of great intensity, as has been done with the yellow arc. The Allgemeine Electricitäts Gesellschaft has endeavoured to patent the simultaneous use of two electrodes each giving a different tint, and claims that in this way the colour of the flame arc can be determined; the phenomenon of changing colours mentioned above is, however, produced also under these conditions.

Experiments with the rare earths (Nernst lamps) have not given the hoped-for results.

U.S. Patent 421,469 recommends the use of minerals with high melting points, cerite, aircone, &c.

Siemens & Halske (D.R.P. 144,463) propose to use nitrides of the rare elements, because these salts contain the highest proportions of the metals, are very resistant to the action of high temperatures, and do not form too much scoria.

In this branch of the subject the number of bodies that can be employed, and the number of patents that can be taken out, are both infinite; the boiling point alone is of importance, as we have pointed out above.

A certain number of patents cover the addition of bodies yielding oxygen, because they start with the idea that the intensity of the light of the arc increases with the temperature.

Conradty recommends the use of $KCrO_3$, BaO_2, Na_2O_2. Strauss (Vienna) passes compressed oxygen from a reservoir through the channel in the cored carbons, or adds peroxide of manganese, or else incorporates metallic aluminium.

Experiments have shown that though the intensity of the light can thus be increased, the consumption of the electrodes becomes so great that industrial application is impossible. The future will show whether it is possible to adapt these carbons for naval service searchlights, for naval projectors, theatres, &c.

It is a known fact that each electric discharge in the air is followed by the formation of ozone; the ozone combines with the atmospheric nitrogen and various nitrous compounds are obtained. The industrial application of this phenomenon is in progress in the establishment of Bradley & Lovegay, at Niagara, where 1 kg. of nitric acid is produced per hour by 15 H.P.

The same reaction takes place on a small scale in the globe of every arc lamp, and the quantity of the product increases with the length of the arc. It is therefore considerable in Bremer lamps, "flame" arc lamps, and projectors. It has been proved by Prof. Wedding that the fluorides in these electrodes are in no way decomposed, and that there is no trace of free fluorine, a gas very voluminous in the air of the globes of arc lamps working with carbons containing fluorine.

It has besides been often proved (see *Eclairage Electrique*, 1903, p. 506; Bradley, *Electrical World and Engineer*, 1902, p. 159) that the exact weight of fluoride added to the carbons can be recovered from the bottom of the globes and the reflectors after combustion. The phantom of poisonous gas exists only in the ignorance of this fact.

All flame carbons and Bremer carbons form nitrous products. These attack the metallic parts of the lamps. Siemens Bros. have suggested to neutralise these nitrous vapours with alkalies (of ammonia and its salts) D.R.P. 137,507, 138,018, 138,019.

Anything new gets exaggerated. There are in use to-day many thousands of flame arc lamps without any precautions against these nitrous bodies. Even in rooms or small shops, &c., flame lamps are nowadays used without injury to the public. Badly-constructed lamps soon get destroyed.

Small current arc lamps have been made to compete with Nernst lamps, and now arc lamps with 2 or even with 1 ampere are in common use. The manufacture of electrodes of small dimensions (4·5, 5·8 and 6 mm.) requires special machinery, but it has not given rise to any progress in the manufacture of the carbons themselves.

The known fact that metals and their oxides can be used as electrodes has naturally been pushed to the farthest extremity. The General Electric Co., of Schenectady, has patented:—

1. Electrodes for arc lamps containing iron or titanium;

2. Electrodes for arc lamps composed of 65 per cent. titanium and 35 per cent. at least of iron.

The chief chemist of this company, Dr. Steinmetz, has published the results of his work in the *Electrical World and Engineer*, 1904, p. 974. He makes these electrodes by compressing finely divided magnetite into iron tubes, which he brazes in the arc. He adds certain salts to steady the arc, and titanium to increase the candle-power.

Haerden (*El. Anzeiger*, 1904, p. 665) claims that the time of burning of these electrodes is much greater than that of carbon, and that the light has a pure white colour. He states that a certain number of these electrodes are in use in some towns in the United States. The negative is a copper disk.

The Deutsche Patent Industrie, Ltd., burns mercury long-life arc lamps. Ordinary carbon electrodes burn in exhausted glass tubes. The lower carbon (the negative one) is surrounded with mercury. The advantages of the rays of the carbon electrodes and of their burning in a vapour of mercury are thus combined. The rate of consumption is said to be only 0·2 mm. per hour (only one tenth of the magnetite lamp), and the specific consumption per standard candle 0·5 watt for a lamp of 880 candles.

The reactions taking place in the flame arc have, moreover, a scientific interest. It is especially remarkable that some salts give to the arc a different colour to that which they give to a gas flame. It is a recognised fact that metallic vapours at high temperatures have additional spectrum lines, and that the lines of the higher temperatures often have a greater intensity than the original lines. In addition, it must be remembered that the emission of light with flame arcs is very complicated, because there are present the line spectra of the metallic vapours, the continuous spectrum of the white-hot carbon particles and the spectra of the surrounding gas atmosphere.

We would explain in the following way the fact that certain substances increase the length of the arc whilst others do not, although all colour it.

The colouring of the arc can be caused (1) by products which are in the form of vapours, but the molecules of which are not yet decomposed; or (2) by substances already entirely reduced.

In the first case a continuous spectrum is obtained, in the second a line spectrum.

Since the two spectra are fundamentally in agreement, and since it is chiefly the metallic vapours which produce the coloration of the light, the colours of the light from such bodies as, say, SrO, SrF_2, BaO and BaF_2, can be very similar, even though with one the combination may be ionised and with the other not. See on this point P. Leonard, "The Arc and the Spectra of Metals," *Annals*, 1903, p. 636.

Arrhenius suggested some years ago (*Wiedemann's Annalen*, 1891, F. L. Tufts *Jahrbuch Radioaktivität*, 1904) that it is very probable that some salts are electrolytically dissociated in the Bunsen flame. This explains why the flame becomes a good conductor of electricity, and why the colour of the flame is independent of the electro-negative radical of the salt.

The salts of the alkalies are completely decomposed in the Bunsen flame, the salts of the alkaline earths only partially, and their spectra approach band spectra.

According to Arrhenius this decomposition is due to water vapour, which cannot be of importance in the flame arc. But still it is possible that under the influence of the very high temperature on the gaseous bodies, an electrolytic dissociation takes place, as is the case with many fused, and some solid bodies.

If there is in the flame arc a substance which is ionised at this temperature, this substance will conduct the electric current, the resistance in the arc itself will be diminished, and the arc will increase in length.

If, on the other hand, substances come into the arc which volatilise without decomposition, that is to say, which are not ionised, the arc can be coloured, but not increased in length.

This last phenomenon is probably produced with several oxides (BaO, CaO, TiO_2, SrO_2) which colour the arc without lengthening it.

The good results obtained with the fluorides are explained by the ease with which fluorides are dissociated, as has been proved by V. Meyer, who, on account of this, claimed and tried to prove that what we call fluorine is not an element.

We have already stated that there is a trace of the formation of nitrous bodies with the ordinary arc; the greatly increased production of these nitrous bodies in the flame arc proves the existence of chemical reactions of a much more violent nature, due probably to the actions of the ion of fluorine with either nitrogen or oxygen. We have mentioned above that there is no free fluorine in the air of flame arc lamps, but, on the other hand, the products of the electrolytic dissociation of the alkaline salts in the Bunsen flame have not been studied either; this difficult work remains to be done. The results will doubtless contribute to the progress of this recent innovation in lighting, the last consequence of which will be the much-wished-for solution of the problem—arc light without combustion of the electrodes.

The work of Rasch and Steinmetz gives us the first indication in this direction. In this connection we may quote the following words of Prof. Lummer (*Ziele der Leuchttechnik*):—

"If we compare the waves of the ether with the sounds of a piano, we see that the method of obtaining light by heating the 'black-body' is equivalent to striking at one time all the keys of this piano in order that we may get the highest octave, which is all we want.

"We can formulate that the chief purpose of the lighting industry is to find a luminous material which ought to send out light rays only, and no rays of heat at all. In other words, the problem consists of finding a light-emitting material which will absorb all rays of light and reflect or transmit all rays of heat.

"This ideal radiating body would consume, as I have found by my experiments, at red heat, 1,000 times less energy, and, even at white heat, 100 times less energy, than the black body referred to above.

"The way to attain this end is to be found in the study of the

electron—the atom of electricity—the bearer of cathode and Becquerel rays.

"To use once again the analogy of the piano, the selection of the electrons corresponds to striking individual keys of the piano; just as, in one case, we can obtain the note we desire, so, in the other, we should be able to obtain the radiations of the requisite wave-length."

MOVING-COIL INSTRUMENTS.

Messrs. Crompton & Co., Ltd., have been engaged during the last two years in working out a system of manufacturing instruments of the moving-coil type for direct currents, in such a way that they can easily be verified and adjusted by the user. The methods by means of which this has been accomplished are described in a

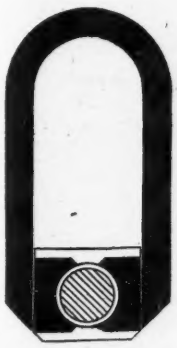


Fig. 1.

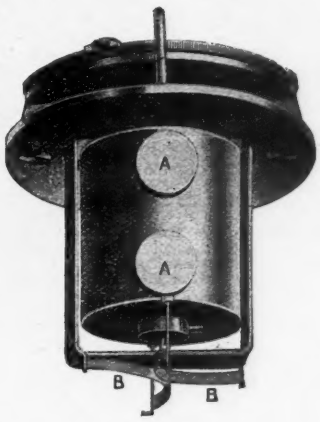


Fig. 2.

booklet to which we drew attention in a recent issue, and we are now enabled to give illustrations of the apparatus in question.

Fig. 1 shows the permanent magnet, with mild steel pole-pieces, which are constructed in a solid block with a pair of brass cheeks, shown unshaded. The sectioned circle represents the steel core. Fig. 2 shows the "movement plug" complete, consisting of the

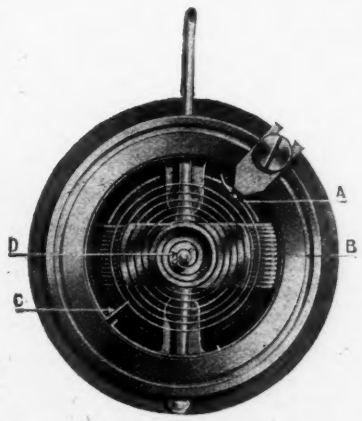


Fig 3.

aforesaid steel core, the moving coil, controlling spring and pointer; this can be withdrawn *en bloc*. The connections with the coil are made, not by way of the controlling springs, but by flexible silver ligaments, B B; the bosses A A are brass studs to centre the plug in the pole-piece block.

Fig. 3 is a plan of the movement plug. The material of the spring is determined solely with regard to its elastic properties, as it carries no current; only one spring is required, and the resistance of the ligaments can be kept very low. The movable ring, B, carries a piece, A, supporting the end of the spring, which passes through a hole in the end of a spring ring, C, while the other end of the spring is fixed to the coil frame at D. The zero can be adjusted by turning the ring B, without altering the control; the latter can be separately adjusted by means of the ring C, which can be moved so as to vary the effective length of the spring.

In fig. 4, a cross-section of the whole movement, A A are the poles of the magnet, B B the pole-pieces, and H the core; C C is the moving coil, and G the ligaments. The pivots supporting the copper frame of the coil are at D D, the lower of which is pushed out by a spiral spring when the set-screw is loosened; F F is the movable ring (marked B in fig. 3). Access to the adjustments is obtained by removing a small glazed cover.

The plugs and seats are made interchangeable in all similar instruments, and the coils are also interchangeable, subject to adjustment of the springs. All shunts for ammeters are adjusted to give a P.D. of 0·075 volt exactly at full load, and are made of manganin. The external resistances of voltmeters are similarly wound to give a current of 0·015 ampere at the maximum or normal reading. The scales of all instruments are marked to correspond with these readings, so that to verify the accuracy of an instrument, it is only

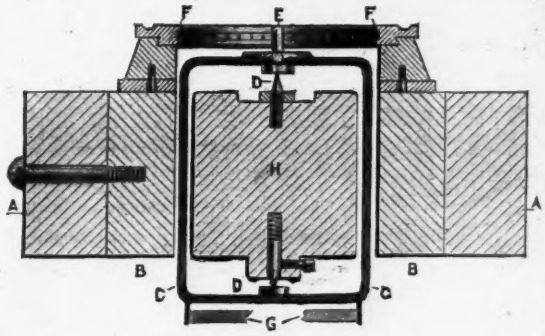


Fig. 4

necessary to adjust the zero and then apply to the moving coil a P.D. of 0·075 volt in the case of an ammeter, or pass through it a current of 0·015 ampere in the case of a voltmeter, when the pointer should come exactly to the mark on the scale. If an error is found, the control is adjusted as already explained. It will be seen that any

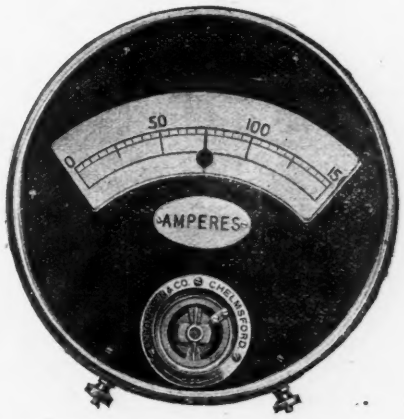


Fig. 5.

instrument can be checked with a single dry cell or a small accumulator, together with an instrument indicating a pressure of 0·075 volt, or a current of 0·015 ampere, as the case may be, and Messrs. Crompton & Co. supply small gauges expressly for this purpose, of the moving-coil type, but having only the gauge-points above mentioned marked on their scales.

Fig. 5 shows a complete ammeter of the type herein briefly described, 8 in. in diameter, pattern A. Several other patterns are made, including edgewise and portable instruments, besides a variety of accessories, for which our readers must refer to the pamphlet itself.

Coal Conveying and Storage Plant.—Messrs. Graham, Morton & Co., Ltd., Leeds, have designed, constructed, and delivered to the Melbourne City Council Electricity Works a large coal and ash-handling plant for the boiler house at the power station. The contract includes the supply of a coal-receiving hopper, jigging screen, four-roll crusher, Graham's patent revolving filler, and 18 in. standard bucket-conveyor, 280 ft. long, one 500-ton steel bunker with roofing, three standard weighing machines, and one ash storage bunker of 12 tons capacity, with the necessary shoots for delivery into carts. The plant is electrically-driven by three separate motors provided with all necessary gearing. The motor for driving the crusher is 12 B.H.P. running at a speed of 600 revolutions per minute; that for driving the coal conveyor is of 15 B.H.P. running at the same speed. They are of the enclosed ventilated type, and suitable for 460 volts D.C.

NEW PATENTS APPLIED FOR.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

23,991. "Improvements in magnetic suspensions for the moving parts of measuring instruments." Allgemeine Elektricitats-Gesellschaft. (Date applied for under Patents Act, 1901, November 6th, 1903, being date of application in Germany.) November 7th. (Complete.)

24,030. "An improved electric time-switch or contactor." F. W. E. Jones. November 7th.

24,065. "Improvements in electric switches." L. Thurnauer and A. D'Orelli. November 7th.

24,078. "Manufacture of single or multiple electric conductors." Societe Industrielle des Telephones. (Date applied for under Patents Act, 1901, March 11th, 1901, being date of application in France.) November 7th. (Complete.)

24,089. "Improvements in or relating to electric motors and controlling devices for use in the electrical propulsion of vehicles." J. S. Raworth. November 7th.

24,093. "An improved receiver for use in wireless telegraphy." J. G. Ralsillie. November 7th.

24,101. "Improvements in automatic machinery for winding wires, cords, electric cables and the like." A. D. Barty. November 8th.

24,102. "Improvements in mountings and connections for electrical conductors, especially applicable to the supports for collecting brushes of dynamo-electric machines." The Phœnix Dynamo Manufacturing Co., Ltd., W. Oelschlager and F. Haddock. November 8th. (Complete.)

24,142. "Improvement in electric interrupters for high-frequency currents." G. E. Johnson. November 8th. (Complete.)

24,145. "An improved thermometer to be used with electricity and in conjunction with various apparatus." B. F. Wickens. November 8th.

24,166. "Improvements relating to electric accumulators." F. Mouterde. November 8th.

24,177. "Improvements in thermo-electric batteries." J. Y. Johnson. (A. Wolf, jun., & Co., Germany.) November 8th.

24,178. "Improvements in the manufacture of thermo-electric batteries." J. Y. Johnson, (A. Wolf, jun., & Co., Germany) November 8th.

24,180. "Improvements in and relating to protective devices for electric transmission systems." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) November 8th.

24,181. "Improvements in systems of electric distribution." The British Thomson-Houston Co., Ltd. (The General Electric Co, United States.) November 8th.

24,190. "Improvements in alternating-current motors, also relating to generators and direct-current machines." V. A. Fynn. November 8th.

24,192. "Improvements relating to electric telegraphy." S. G. Brown. November 8th.

24,200. "Improvements in electric switches." P. L. Clark. November 8th. (Complete.)

24,225. "Improvements in wheel-guards and obstruction removers for electric tramcars or other electrically-driven vehicles." E. N. Nicholson. November 9th.

24,276. "Improvements in alternating-current motors." V. A. Fynn. November 9th.

24,310. "Improvements in lighting by means of Nernst electric lamps or the like." G. Wilkinson. November 10th.

24,316. "Improvements in electric arc lamps." A. Eckstein and A. E. Angold. November 10th.

24,323. "Improvements in and relating to electric traction." J. Birkbeck. November 10th.

24,341. "Improvements in electric switches." O. D. Lucas. November 10th.

24,343. "Improvements in electric signs." J. Heinemann. November 10th.

24,351. "Improvements relating to dynamos and other rotary electric machines." M. Walker. November 10th.

24,358. "Improvements in carbon feeding mechanism for electric arc lamps." G. D. Mantle. November 10th.

24,369. "Improved arrangement of electric emergency lamps in theatres and like buildings." F. Brandt. November 10th. (Complete.)

24,379. "Improved means for use in connection with electric motors and centrifugal separators or other apparatus driven by such motors." W. H. Scott and R. Williamson. November 10th.

24,384. "A combined mouth gag and electric light." J. S. D. MacCormac and The Dental Manufacturing Co., Ltd. November 10th.

24,388. "Improvements in electric circuit breakers." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) November 10th.

24,389. "Improvements in controlling devices for electric motors." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) November 10th.

24,390. "Improvements in insulators for the live rails of electric railways, tramways and the like." O. Erlands. November 10th.

24,399. "Improvements in electric tools." P. Schiemann. November 10th. (Complete.)

24,423. "Improvements in electricity meters." Chamberlain & Hookham, Ltd., and S. H. Holden. November 11th.

24,429. "Improvements in telephone systems." W. Aitken. November 11th.

24,432. "Improvements in or relating to electro-mechanical synchronisation apparatus." B. Bonniksen. November 11th.

24,448. "An improved multiple-filament incandescent lamp." J. Klopfenstein. November 11th.

24,470. "Improvements relating to electric gas or vapour apparatus." P. C. Hewitt. (Date applied for under Patents Act, 1901, November 24th, 1903, being date of application in United States.) November 11th. (Complete.)

24,477. "Improvements in or connected with electric arc lamps." F. M. Lewis, G. W. Lewis Case and The Reason Manufacturing Co., Ltd. November 11th.

24,485. "Improvements in electric meters." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) November 11th.

24,538. "Improvements in electrical fuses." B. Thomas and G. Thomas. November 12th.

24,539. "Improvements in automatic electric switches or circuit-breakers." B. Thomas and G. Thomas. November 12th.

24,560. "Electric testing clip." H. Frankel. (Date applied for under Patents Act, 1901, January 19th, 1904, being date of application in United States.) November 12th. (Complete.)

24,569. "Improvements relating to the supply of current to electric vehicles." O. H. Baldwin. November 12th.

24,572. "Improvements in connection with electric igniters for internal combustion engines." The Marquis Albert de Dion and G. Bouton. (Date applied for under Patents Act, 1901, August 16th, 1901, being date of application in France.) November 12th. (Complete.)

24,573. "Improvements in dynamo-electric machines." A. F. Batchelder. (Date applied for under Patents Act, 1901, November 12th, 1903, being date of application in United States.) November 12th. (Complete.)

PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson & Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps).

1903.

Electric Railways. W. M. Eader. 21,316. October 2nd.

Maintaining Two Electric Motors in Synchronism. Siemens Bros. & Co., Ltd. (Siemens & Halske, Actien Gesellschaft, Germany.) 21,305. October 3rd.

Electric Lamps. J. B. B. Burke. 21,306. October 3rd.

Electric Signalling. C. F. Brodin and H. A. Schepeler. 21,320. October 5th.

Electric Accumulators. J. E. G. Merau. 21,368. October 5th.

Electric Arc Lamps. J. Jeannot and F. de Zea Bermudez. 21,466. October 6th.

Apparatus for Evaporating the Type Bands for Automatic Telegraph Transmitting Apparatus and the like. Siemens Bros. & Co., Ltd. (Siemens & Halske, Actien Gesellschaft, Germany.) 21,493. October 6th.

Electro-Magnetic Signalling Apparatus. Siemens Bros. & Co., Ltd. Siemens & Halske, Actien Gesellschaft, Germany.) 21,592. October 7th.

Rheostat. F. M. Short. 21,596. October 7th.

Electro-Deposition of Metals Upon Aluminium. J. Cheswick and H. Shaw. 21,609. October 8th.

Electrical Alarm Clock. H. Peters. 21,637. October 8th.

Connections or Terminals for Electric Battery Plates and Other Articles or Structures Composed of Lead or Lead Alloys. E. W. Jackson. 21,650. October 8th.

Ships' Telegraphs. T. C. Walters. 21,742. October 5th.

Valve Brake Controlling Mechanism for Steam or Electric Winding or Hoisting Machines. T. C. Futers. 21,793. October 9th.

Dynamo-Electric Machinery. J. H. St. Hill Mawdsley. 21,972. October 12th.

Starting Switches for Electric Motors. T. E. Weaver. 21,984. October 13th.

Multipolar Electric Generators and Motors. T. L. Boyden. 22,008. October 13th.

An Apparatus for Establishing Electrical Correspondence. L. Despradels. 22,087. October 13th. (Complete.)

Trolley or like Current Collectors for Electric Traction. A. B. Upham. 22,097. October 13th.

Electric Accumulators. B. Becker. 17,663. August 14th.

Socket Joints of Metallic Telegraph Poles and other like Poles. Bullers, Ltd., and E. J. Chambers. 17,630. August 14th.

Reversing Mechanism for Dynamos. F. W. Manley. 17,603. August 14th.

Electric Lighting of Trains. H. Hill. 17,602. August 14th.

System of Electric Lighting. H. Leitner. 17,601. August 14th.

Processes of Insulating Coils. E. A. Carolan. (The General Electric Co. United States.) 18,251. August 24th.

Improvements in Electric Battery Jars. A. Ford-Lloyd. 18,319. August 25th.

Electric Telegraphy. L. G. Brown. 19,251. September 7th.

Apparatus for Use in Laying Pipes for Sewers, Drains, Electric Light, Gas and Watermain, and such like. B. T. Haynes. 19,341. September 8th.

Apparatus for Reducing or Preventing the Production of Sparks at the Collectors or Commutators of Dynamos, Electric Motors and the like. R. Thury of the firm Cie de l'Industrie Electrique & Mechanique. 19,419. September 9th.

Systems of Controlling Alternating Current Motors. G. F. Scott. 19,520. September 10th.

Electric Fuses and the Like. G. B. Baby. 19,882. September 15th.

Coin Mechanism Especially Applicable to Electricity and Other Meters. E. Du Bois. 20,072. September 17th.

Engine Telegraphs or Signals on Board Ship. M. G. Isdale. 21,140. October 2nd.

An Electro-Mechanical Arrangement for Changing Speed and for Reversing. P. J. M. Gasnier. 21,173. October 2nd.

Dymamo-Electric Machines and Electric Motors. E. A. Fagerlund. 21,224. October 3rd.

Automatic Telephonic Installations. B. Kugelmann. 21,302. October 3rd.

Loss of Heat from Iron Pipes.—The Canadian Society of Civil Engineers publishes a paper by Mr. R. W. Leonard on the above subject, which deals with the loss of heat from pipes carrying warm water. He made experiments on 1-in. and 2-in. pipes, black, and rusty black, of ordinary type, on 2-in. pipe of 28 and 26 gauge, or 0·016 in. and ·018 in. thick, on 2-in. lap-welded boiler tube, and 1-in. welded galvanised steam pipe. The pipes were filled with warm water and exposed to air. A 2 in. black pipe 0·154 in. thick containing 5 lbs. of water had a surface of 2·20 sq. ft., being 3·54 ft. long. It cooled from 142° F. to 32° F., and lost heat at the rate of 124 B.Th.U. per hour in still air at 7° to 10° F. Cooled from 126° to 32°, the loss was 112·6 units under the same conditions, and 217·3 units in an air current of 8 to 12 in. per second at 5° to 7° F. of temperature, thus showing the extreme importance of non-movement. In water at 32° F. the same pipe lost heat at the rate of 309 units per hour when cooled from 126° to 32°, and at 269 units when cooled only from 116° to 32°. In a current of only 1½ in. per second of water at 32°, and cooling from 116° to 32°, the loss was as high as 849 units per hour. Cooled from 142° to 32°, a 2-in. pipe only 0·095 in. thick cooled at the rate of 136·7 units in still air of 7° to 10°, of 385 units in still water at 32° F., and of 1,005 units in a current of 1½ in. per sec. Thin galvanised pipes lost heat at higher rates, and thin tinned pipes at still higher rates. The figures obtained are consistent. The special use of the information seems to be to assist in calculating how much water must be pumped through the hollow bars of a rack in a mill-flow to prevent the adhesion of frazil ice. A very slight rise of temperature will stop the adherence of frazil. It is recommended that the circulating fluid be something freezing at a low temperature, so as not to solidify when pumping is stopped. The amount of warm fluid to be circulated at, say, 66°, is not great, for a very slight excess of temperature will suffice.